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WAR DEPARTMENT
THE ADJUTANT GENERAL'S OFFICE

MUSKETRY

WASHINGTON
GOVERNMENT PRINTING OFFICE
1917

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THE ADJUTANT GENERAL'S OFFICE

MUSKETRY

WASHINGTON
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WAR DEPARTMENT.

Document No. 631.

Office of The Adjutant General.

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WAR DEPARTMENT,
WASHINGTON, *July 18, 1917.*

The following manual on "Musketry" is approved and published for use in the instruction and training of the Armies of the United States.

[062.001, A. G. O.]

BY ORDER OF THE SECRETARY OF WAR:

TASKER H. BLISS,
Major General, Acting Chief of Staff.

OFFICIAL:

H. P. McCAIN,
The Adjutant General.

383200

PREFACE.

An organization's ultimate efficiency in battle-field firing is dependent upon the thoroughness of its training in individual marksmanship, leadership, and teamwork.

Maximum results can not be obtained by (1) a poor shooting company under the best of leadership, (2) a good shooting company under poor leadership.

There can be no serious discussion among military men as to the relative value of individual and collective training in shooting, as one is dependent upon the other.

The course as given in the Small Arms Firing Manual for the development of the individual marksman should be carefully followed and every effort made to bring each man to as near a state of perfection as possible.

It must be remembered, however, that the soldier is being trained to work as one of a team, hence hand in hand with the training of the man to shoot should go the instruction and training to fit him to intelligently play his part in that team, be that part a leader or follower.

Musketry is nothing more than teamwork in the conduct of fire. Instruction must be systematic if the best results are to be obtained. The principles involved are first explained and then by practical demonstration, or actually doing it himself, the soldier has impressed upon him the lesson it is desired to teach, or, in other words, he is first taught the **WHY**, and then by actually seeing the thing done or by doing it himself he learns the **HOW**. This **HOW** is the important consideration, as Hohenloe in his letters on infantry says:

"The officer commanding a company very rarely finds himself in war in a position to make great tactical, and still less to make strategical, evolutions.

"His objective, whether in the offensive or the defensive, is, as a rule, very clearly marked out for him. But the struggle, so far as he can influence it, is decided by **HOW** he carries out

his work, by **HOW** his men take advantage of the ground, **HOW** they find cover, **HOW** they shoot, and **WHETHER** they hit, and **HOW** they obey signals with regard to advancing, lying down, aiming, and the nature of fire."

The object of the book is to present to the company officer a text on the **WHY** and **HOW** of **MUSKETRY.**

The subject matter of this volume is based on the courses of instruction at the School of Musketry at Fort Sill, Okla.

It is a compilation by Capt. O. P. Robinson, Nineteenth Infantry, director of the experimental department of this school. It covers as completely as possible in a volume of this size the subject, and is, for the most part, based upon the course of **MUSKETRY** as taught at this school, and upon Maj. H. E. Eames' well-known book, "The Rifle in War."

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MANUAL ON MUSKETRY.

CHAPTER I.

THE CONDUCT OF FIRE.

1. The conduct of fire includes fire direction, fire control, and fire discipline.

FIRE DIRECTION is the function of the captain and higher commanders. Above the grade of captain the direction is principally tactical. The maximum fire effect of an organization is attainable only through efficient fire direction. Efficient fire direction, on the part of the captain, implies the ability quickly and accurately to estimate any given situation, arrive at a correct decision, and to issue simple and effective orders to carry out that decision.

FIRE CONTROL is the function of subordinate leaders and their assistants within the company. It consists of the issue and transmission of orders and of the enforcement of fire discipline in such a manner as to carry into effect the will of the fire director.

FIRE DISCIPLINE is a term used to express the degree to which the individual riflemen of an organization are amenable to fire control.

As applied to an organization, the expression "good fire discipline" implies, first, that the individual riflemen possess the knowledge and training requisite to good marksmanship, and, second, that their state of mind is such that their expert knowledge and training is placed promptly, willingly, and intelligently at the disposal of their leaders, to be used in delivering an effective fire when, where, whence, and in such manner as the latter may dictate, and this in rigorous subordination of their own will.

Similarly applied, the expression "poor fire discipline" implies that some or all of the riflemen of the organization are lacking in one or both of the essential attributes of "good fire discipline."

In musketry, the instructor must distinguish between the things which the men merely need to know or to understand and those which need to be practiced until they become habits.

For instance, the men should be taught:

Military terms.
The fundamentals of the theory of rifle fire.
The principles used in the construction and operation of the instruments used in the direction and control of fire.
A system in the designation and recognition of targets.
To use their eyes.
The use of auxiliary aiming targets.
Battle-field communication.
The use of cover.
Battle-field reconnaissance.
The fundamentals of fire tactics, consisting of—
Troop leading.
Choice of target.
The distribution of fire.
The density of the firing line.
The determination of the range.
The time of opening fire.
The kinds of fire.
The rate and volume of fire.
The distance between echelons.
The service of observation of the enemy.
The ammunition supply.

The officer, to be qualified as an instructor, must understand:

The construction and solution of fire problems, and exercises with and without ball ammunition.
The duties of umpires, including the making of the critique, and use of umpire's reference tables.
The duties of the statistical officer.

On the other hand, the men must be trained by practice and repetition until the things they should do on the battle field have become fixed habits with them.

The following outline gives in convenient form the duties of the personnel in the conduct of fire:

NOTE.—It is to be emphasized that all officers and noncommissioned officers must be thoroughly familiar with the duties of all below them.

I. THE PRIVATE.

2. Position.—Deployed in line: One yard per man (125, I. D. R.), unless a greater extension is directed in the order for deployment (126, I. D. R.).

3. Duties.—(6, 42–47, 104, 133, 134, 138, 139, 149, 152–156, 203, 209, 233, 247, 251, 254, 255, 319, 354, and 367, I. D. R., and 209, S. A. F. M.)

The individual soldier must be trained:

1. **To obey commands promptly and without question.**
2. To transmit simple verbal messages rapidly and accurately.
3. To transmit and receive battle-field signals.
4. To recognize targets from description quickly.
5. To describe and define targets.
6. To use rear sight in describing targets.
7. To use horizontal and vertical clock systems, singly or in combination in describing targets.
8. To set sights quickly and accurately as ordered.
9. To bring piece to shoulder, aim carefully and deliberately from habit, and to reload quickly.
10. To fire at the ordered rate.
11. To fire at the part of the designated objective which corresponds to his position in the firing line, unless otherwise directed.
12. To continue firing in the designated sector and not to change therefrom unless ordered.
13. Not to slight invisible parts of the target for more visible ones.
14. To maintain constant observation to the front.
15. To utilize folds of ground for concealment in advancing and firing.
16. To distinguish between concealment and defilade.
17. To select firing positions.
18. To recognize dead ground in his vicinity.
19. To recognize a good and bad field of fire.
20. To understand effects of visibility and the selection of backgrounds.
21. To fire from all positions, from behind hillocks, trees, heaps of earth and rocks, depressions, gullies, ditches, doorways, and windows.
22. To obey promptly orders to suspend and cease firing.

23. To ignore whistle signals, except suspend firing.
24. To watch closely for the expected target after having suspended firing.
25. To drop into the nearest interval when reinforcing the firing line, and obey the orders of the nearest squad leader.
26. To transmit firing data rapidly and accurately to men of the supports joining the firing line, and this without decreasing his own rate of fire.
27. To call for range and target when reinforcing firing line.
28. To have confidence in his own ability to hit.
29. To a system of sight setting and fixing bayonets in order that there may be no cessation of fire in the unit during this operation.
30. To prepare for rushes without decreasing the fire of the unit unduly.
31. To avoid unnecessary movement in preparing for rushes.
32. To spring forward at command, "Rush!" or, "Follow me!" without preliminary rising.
33. To avoid bunching in rushing.
34. Not to swerve to the right or left in search of cover, but to advance in a straight line in order not to blanket the fire of men in his rear.
35. To drop quickly at end of rush and crawl up to the line if in rear of it.
36. To appreciate the comparative vulnerability of men—
    (*a*) Making long rushes.
    (*b*) Making short rushes.
37. To remain with his own company, but if he accidentally becomes separated from his company or squad to join the nearest one.
38. To maintain silence except when transmitting or receiving firing data and charging.
39. To retain presence of mind.
40. To be careful not to waste ammunition.
41. To use the 30 rounds of ammunition in the right pocket section of the belt only upon the order of an officer.

42. To remain with the firing line after bringing up ammunition.
43. To utilize ammunition of the dead or wounded.
44. Never to attempt to care for dead or wounded during the action.
45. To have confidence in his ability to use the bayonet.
46. To a firm determination to close with the enemy.
47. To preserve the line in charging.
48. To understand that a charge should be slow and steady. (The more agile men must not run away from the slower ones.)
49. To form up immediately after the charge and follow the enemy with fire, not attempting a disorganized pursuit.
50. To understand that it is suicidal to turn his back to an enemy, and that if he can not advance he must intrench and hold on until dark.
51. To construct hasty cover giving him protection from rifle and shrapnel bullets.
52. To intrench himself at night.
53. To conceal his trench.
54. To provide himself with substantial head cover.
55. To protect himself from flank and enfilade fire.
56. To make loopholes giving him a wide field of fire.
57. To make his trench a comfortable one, so that he can sit in it for several hours without constraint.
58. To count distant groups of objects or beings.
59. To recognize service targets.
60. **Never to fire until he understands what the target is, at what part he is to fire, and with what sight setting.**

II. CORPORAL.

4. Position.—(1) Marching in line as center skirmisher of squad (124, I. D. R.) or, (2) when skirmish line is halted, immediately behind his squad.

5. Duties.—(Pars. 42, 222, 252, 254, 255, 411, and 551, I. D. R., cover in general the corporal's duties.)

1. Receives his instructions from the platoon leader.
2. Announces sight setting.
3. Points out indicated objectives to his squad.

4. Assigns as the squad target that portion of the platoon target which corresponds to the position of the squad in the platoon.
5. Announces class and rate of fire.
6. When his squad is ready to fire, looks toward the platoon leader and holds up his hand. At the platoon leader's signal to commence firing, he sees that the squad opens fire.

Thereafter—

1. Requires all to fire from the shoulder.
2. Requires all to use ordered rate of fire.
3. Assures himself that all fire at designated objective.
4. Prevents slighting of invisible portions of the target for more visible parts.
5. Prevents men from changing fire to unauthorized targets not in the assigned front or sector.
6. Maintains constant observation to the front when squad is firing, for effect of fire; when squad is not firing, for appearance of enemy.
7. Insures prompt obedience to orders to suspend and cease firing.
8. Makes men utilize ground to fullest extent for concealment in firing and advancing.
9. In sight setting, changing sights, and fixing bayonets has front rank perform operations first (rear-rank men increasing rate of fire) and then the rear rank follow while the front-rank men make up for loss of fire for the rear rank, thus insuring that the rate of fire for the squad does not fall off.
10. Prevents increasing vulnerability of the squad while preparing for a rush, and rushes as soon after cease firing as possible.
11. When other squads of his platoon are rushing, or the platoon which is covering the same target as is his platoon is rushing, he has his squad increase its rate of fire to make up for the lost-fire effect of the rushing element.
12. In rushing, causes men to spring to feet, running at full speed; all men drop to the ground at the same time, and those who are in rear to crawl up to the line.

13. When reinforcing the firing line, takes over the duties of disabled squad leaders. For this purpose his squad may drop into line at one place and he may move to the right or left where there is a squad leader needed. If there are no vacancies caused by disabled squad leaders, he drops into line and assists the squad leaders who are there.
14. Prevents decreasing rate of fire when men are transmitting data to arriving supports.
15. Prevents wasting of ammunition.
16. Prevents use of 30 rounds in right-pocket section of belts, except on order of an officer.
17. Distributes ammunition of dead and wounded and ammunition brought up from rear.
18. Prevents decreasing the rate of fire while ammunition is being distributed, or when at other times there is reasonable assurance that the fire will continue to be effective without further control.
19. Notifies the platoon leader when the ammunition in the bandoliers has been used.
20. Looks to the rear only at the sound of his platoon leader's whistle "Attention."
21. Takes his position in rear of his squad when it is firing and remains there, where he can control its fire, and only crawls into line and adds his rifle when all control is lost (short ranges).
22. To control his squad he does not walk up and down behind it, but rolls along behind his line and keeps down.
23. Leads his squad in moving to the front or rear.
24. Must know thoroughly the drill regulation signals, and have a good practical knowledge of the theory of fire.
25. In rushing, maintains the direction of advance of his squad, so as not to blanket the fire of squads in his rear.
26. Takes advantage of every lull in the action and every favorable opportunity to reorganize his squad and get it more under control.
27. Checks every breach of fire discipline, abates excitement, and prevents any man from leaving the squad to go to the rear for any purpose whatsoever.

28. If called out of line to act as guide, notifies designated private (103, I. D. R.) to take command of squad.

III. PLATOON GUIDES.

6. **Position.**
   1. Behind firing line, near the platoon leader. (163, I. D. R.)
   2. Advancing in line, behind center of platoon. (213 and 223, I. D. R.)
   3. "Advance by thin lines," leads even numbered lines. (218, I. D. R.)

7. **Duties.**—(104, 213, 223, 229, 252, 367, 375, and 376, I. D. R.)
   1. The platoon leader's assistant, and may be assigned any duty the platoon leader sees fit.
   2. Keeps adjoining units under observation.
   3. Watches firing line.
   4. Checks every breach of fire discipline.
   5. Prevents skulking, men leaving the ranks at any time to care for wounded, etc.
   6. Designates new squad leaders and organizes new squads when necessary.
   7. Attaches men that have become separated from their own squads to other squads.
   8. Insures prompt and orderly advance.
   9. On joining firing line from the support takes over duties of sergeants disabled.
   10. May receive and transmit signals to the captain.
   11. If the platoon leader is disabled, he takes over his duties. Hence he should know what the platoon leader is doing and how.
   12. When taking over the duties of the platoon leader he calls the senior corporal of his platoon out to act as guide.

IV. THE PLATOON LEADER.

(The fire controller.)

8. **Position.**—Where he can best—
   1. Control the squads constituting his platoon. (252, I. D. R.)
   2. Observe the target and fire effect. (252, 414, 415, I. D. R., and 216, S. A. F. M.)
   3. Observe the captain for signals or commands. (234 and 251, I. D. R.)

4. In "Advance by thin lines," leads odd numbered lines. (218, I. D. R.)

9. Duties.—(6, 42, 104, 229, 231–233, 244, 245–257, 319, 375, and 550, I. D. R.) Controls the fire of his platoon and in his fire orders—

1. Receives his orders from the company commander.
2. If necessary, may indicate the fire position that has been ordered.
3. Announces sight setting.
4. Points out designated targets to his platoon, if practicable; otherwise to his corporals only, or
5. When the target can not be seen, indicates an aiming target.
6. Assigns targets to insure that the entire front or sector given him by the company commander will be covered with fire.
7. Gives class of fire.
8. Announces rate of fire.
9. If commanding a flank platoon, details a man to watch for signals from the combat patrols.
10. When his corporals have signaled that their squads are ready to fire, signals the captain by looking toward him and holding up hand.
11. When captain signals "Commence firing," repeats same to corporals.

Thereafter—

1. Observes for fire effect.
2. When platoon is not firing, takes the necessary steps to insure that the front assigned is kept under constant observation for any appearance of the enemy or any change of position.
3. Changes sight setting of his platoon when necessary.
4. Regulates rate of fire.
5. Increases rate of fire when large and distinct targets appear, and decreases it when the target becomes small and indistinct.
6. Prevents decrease in rate of fire when—
   (*a*) Changing sight setting.
   (*b*) Preparing for rushes.
   (*c*) Fixing bayonets.
   (*d*) Transmitting firing data to supports.
   (*e*) Distributing ammunition.

7. Increases the rate of fire to cover the advance of adjacent units; for this purpose progress and movements of adjoining units are kept under observation.
8. Maintains direction of advance of his platoon in rushing, so as not to blanket fire of adjacent units.
9. Is on the alert for captain's commands or signals; for this purpose he may use his platoon guide.
10. May use his platoon guide to observe adjoining units.
11. Must understand all signals.
12. Leads his platoon in advancing and charging.
13. Prevents changing fire to unauthorized targets.
14. Insures distribution of ammunition brought up from the rear and the collection and distribution of same from dead and wounded. (550, I. D. R.)
15. Notifies the company commander when the ammunition in the bandoleers has been used.
16. In coming up with reinforcements, he takes over the duties of disabled platoon leaders of the platoons into which his men have dropped, or it may be some other section of the line needs his service, in which case he goes there.
17. Endeavors to preserve the integrity of squads, designates new squad leaders to replace those disabled, organizes new squads when necessary, sees that every man is placed in a squad, and takes every opportunity for restoring order in the firing line. (104 and 375, I. D. R.)

V. THE FIRST SERGEANT.

9. Commands a platoon.

VI. RANGE ESTIMATORS.

10. Five or six officers or men, selected from the most accurate estimators in the company, are designated "Range Estimators." (240, I. D. R.)

Duties.—To estimate the range to target when directed to do so.

VII. BUGLERS.

11. Position.—Joins the captain when the company deploys. (164, I. D. R.)

Duties.—(235, I. D. R.)

1. One bugler—
   - (*a*) Observes the enemy.
   - (*b*) Observes the target.
   - (*c*) Observes for fire effect.
   - (*d*) Watches platoon leaders for signals.
   - (*e*) Transmits signals to platoon leaders.
2. The other—
   - (*a*) Watches the major for signals and repeats them back.
   - (*b*) Transmits information to the major.
3. Both—
   - (*a*) Repeat bugle signal "Charge." (319, I. D. R.)
   - (*b*) Carry field glasses, message pads, pencils, and signal flags. (I. U. A. E. M., 387, I. D. R.)
   - (*c*) Act as messengers.

All the foregoing requires that they be proficient in—

- (*a*) Signaling; hand, arm, and letter codes.
- (*b*) Observation for fire effect.
- (*c*) Location and definition or description of targets.
- (*d*) Bugle calls.

VIII. THE CAPTAIN.

(The fire director.)

12. Position.—Where he can best—

1. Control his four platoons. (248, I. D. R.)
2. Observe fire effect. (249, I. D. R.)
3. See the major and platoon chiefs. (234, I. D. R.)

13. Duties.—Before fire action:

1. In compliance with the major's orders, conducts his company to the place of deployment in the best manner. (212 and 297, I. D. R.)
2. Designates target and allots part to each platoon. (245 and 249, I. D. R.)
3. Determines the range. (240 and 249, I. D. R.)
4. Announces sight setting. (249, I. D. R.)

5. Indicates the class of fire. (249, I. D. R.)
6. Time to open fire. (249, I. D. R.)
7. Informs the subordinates as to the location of the battalion commander and, when necessary, announces his own position.

During the action:

1. Observes fire effect. (249, 414, 415, I. D. R., and 216, S. A. F. M.)
2. Corrects material errors in sight setting. (249, I. D. R.)
3. Prevents exhaustion of ammunition. (249, 550, and 551, I. D. R.)
4. Distributes ammunition received from the rear. (249 I. D. R.)
5. Provides for the collection and distribution of the ammunition of the dead and wounded. (551, I. D. R.)
6. Notifies the major when the ammunition in the bandoleers has been used.
7. Is on the alert for the major's signals or commands. (226 and 234, I. D. R.)
8. In the absence of express directions from the major, if commanding a flank company, determines when advances by rushes shall be attempted. (311, I. D. R.)
9. Indicates size of fractions to rush. (311, I. D. R.)
10. Leads a rush by entire company. (223, I. D. R.)
11. Leads the charge. (319, I. D. R.)
12. When necessary, designates new platoon leaders and sees that new squads are organized and new squad leaders designated to replace those disabled. (104 and 375, I. D. R.)

IX. BATTALION STAFF.

14. Positions.—Battalion adjutant and battalion sergeant major, with major.

Mounted orderlies, both with major (one with major and one with adjutant) until horses are sent to rear, when both may be with the horses or one take the horses and the other remain with the major.

15. Duties.—All assist the major in any way directed by—

(*a*) Reconnaissance. (565, I. D. R., and 25, F. S. R.)

(*b*) Observation of the firing line.

(*c*) Maintaining contact with regimental headquarters.

(*d*) Maintaining contact with the support.

(*e*) Receiving, communicating, and sending visual signals from and to front and rear.

(*f*) Observing fire effects and progress of events.

(*g*) Keeping copiés of all orders, messages, and other data necessary for his war diary. (35, F. S. R.)

When there is only one range finder to the battalion, the battalion sergeant major is the "Battalion range taker." When not actually engaged in taking ranges, he assists the major as heretofore outlined or, preferably, he may be charged with the duty of maintaining communication with the companies of the firing line.

The major designates a sergeant to take charge of the battalion combat train. Under the major's direction, this sergeant—

(*a*) Conducts the combat train as far to the front with the battalion as directed.

(*b*) Issues ammunition to the battalion.

(*c*) Takes the combat train to rendezvous for refilling, under direction of the regimental commander. The empty combat wagons of a brigade are usually sent to the distributing station in a body.

(*d*) Rejoins the battalion, if it is not in action, or, if it be engaged, joins or establishes communication with the regimental reserve. (548, 549, and 553, I. D. R.)

X. THE MAJOR.

The battalion is the attack unit whether acting alone or as a part of a larger force. (305, I. D. R.)

16. Position (the general rules for a colonel apply).

1. Where he can best—

(*a*) Direct the reinforcing of the firing line from the support. (315, I. D. R.)

(*b*) Observe the progress of events. (369, I. D. R.)

(*c*) Maintain contact with regimental headquarters. (369, I. D. R.)

2. On the firing line when all the supports have joined. (315, I. D. R.)

17. Duties.—

GENERAL RULES.

1. Conducts his battalion according to the sector and the mission assigned him.
2. Directs first disposition of the battalion by tactical orders, giving subordinates—
   - (*a*) Information of the enemy.
   - (*b*) Position of supporting and neighboring troops.
   - (*c*) The general object to be attained.
   - (*d*) The special problem for each company. (291, I. D. R.) 303 I. D. R. the primary apportionment of the target.
   - (*e*) The point of time, if practicable, at which the fire fight is to open. (304, I. D. R.)
   - (*f*) Orders for flank protection and reconnaissance, unless specifically provided for by higher authority. (293, 397, and 398, I. D. R.)
   - (*g*) His position and that of the next higher commander.
3. Controls, supports, dispatches, reinforcements from support to firing line. (226 and 297, I. D. R.)
4. Controls subsequent movements by suitable orders or commands. (291, I. D. R.)
5. Regulates ammunition supply, under which heading he (316 and 317, F. S. R.; the combat train is the immediate reserve supply of the battalion)—
   - (*a*) Is responsible for the proper use of the combat train.
   - (*b*) Insures maintenance of the prescribed allowance at all times.
   - (*c*) Causes combat trains to march immediately in rear of the battalion unless directed otherwise. (548, I. D. R.)
   - (*d*) When battalion deployed on his own initiative, indicates whether extra ammunition shall be issued. (294, I. D. R.)
   - (*e*) When battalion deployed pursuant to orders from higher authority, causes issue of extra ammunition unless specifically ordered not to do so. (294 and 548, I. D. R.)

(*f*) When combat wagons are emptied, directs them to proper rendezvous to be refilled. (548, I. D. R.)

(*g*) Sees that combat wagons and belts of men are refilled as soon as possible after an engagement. (553, I. D. R.)

6. Maintains contact with adjoining troops. (399, I. D. R.)
7. May harmonize ranges used by the companies on the firing line.
8. Determines when bayonets shall be fixed. (318, I. D. R.)
9. Subject to orders from higher authority, determines the point from which the charge is to be made. (319, I. D. R.)
10. Orders the charge. (318, I. D. R.)

SPECIAL.

1. **In attack:**
   (*a*) May select formation in which companies advance. (212, I. D. R.)
   (*b*) Designates—
      1. The direction of the objective. (303, I. D. R.)
      2. The companies for the firing line.
      3. The companies for the support.
      4. The order and front of the companies in the firing line.
      5. The right or left company of the firing line as the base company.
      6. If he desires, when the advance by rushes is to start. (311, I. D. R.)
2. **In defense:**
   (*a*) Describes the front of each company. (292, I. D. R.)
   (*b*) Assigns sector of fire. (244 and 302, I. D. R.)
   (*c*) Locates fire, communicating, and cover trenches.
   (*d*) Directs preparation of obstacles.
   (*e*) Assigns companies to construct trenches and obstacles.
   (*f*) Details troops to occupy trenches. (321, I. D. R.)
   (*g*) Causes firing line and supports to fix bayonets when a charge by the enemy is imminent. (324, I. D. R.)
   (*h*) Seeks opportunities for counter attack. (326, I. D. R.)

XI. THE COLONEL.

18. Position (369, 380, and 528, I. D. R.)

1. Advancing to the battle field as—
   (*a*) Independent commander ordinarily marches with the advance guard in order that he may—
      1. Receive information promptly.
      2. Personally see the situation (reconnoiter).
      3. Order the deployment.
      4. Begin the action strictly in accordance with his own wishes.
   (*b*) Subordinate commander. (427, I. D. R.) After receiving his order for the action, precedes his command as far as possible in order to—
      1. Personally reconnoiter the ground.
      2. Be prepared to issue his orders promptly.
2. During the action, such as will enable him to—
   (*a*) Observe the progress of events.
   (*b*) Receive and transmit messages and orders.
   (*c*) Be in constant, direct, and easy communication with the reserve. (369, I. D. R.)

19. Duties:

(*a*) After having received his orders, the regimental commander leads his regiment forward in column or in line of columns until the time arrives for issuing the regimental order. He then (426, I. D. R.)—

(*b*) Assigns targets and sectors or tasks to battalions and special units. (342, 381, and 426, I. D. R.)

(*c*) Provides for necessary reconnaissance to front and flank. (428, I. D. R.)

(*d*) Announces his position and also that of the next higher commander.

(*e*) Controls the reserve as the tactical situation demands. (441, I. D. R.)

(*f*) Regulates ammunition supply. (316, F. S. R., and 552, I. D. R.)

NOTE.—The colonel is assisted in the performance of his duties by the regimental staff.

CHAPTER II.

MILITARY TERMS.

20. The average man upon enlisting in the Army finds himself in a little community set apart from the rest of the world, strange in its life, its customs, and its language.

Misunderstandings are avoided and instruction facilitated if the recruit in his early training is taught to talk the language.

The following exercise is suggested: The squad is taken to some prominent point from which there is a good view of the surrounding country, or, if available, a landscape target may be used.

The instructor describes in detail simple prominent features, such as a part of the skyline or the line of a bank or hedge, and then requires each man in the squad to describe in similar terms another part of that line. The men are instructed as to:

Skyline, horizon, crest of hill, ridge, knoll, peak, cliff, col or saddle, gentle slope, steep slope, hollow or valley, spur, ravine, clearing, fold in the ground, dense cover, culvert, cut embankment, sunken road, parapet, crossroads, road fork or road junction, right and left bank of a stream, a path.

The shape and nature of the ground is described; whether it is level, undulating, or broken; rock, sandy, or pasture land.

Natural and artificial features, the different kinds of trees, fences, undergrowth, and the shape and size of the fields with the color of the earth or crops growing are pointed out and explained.

The approximate measurements of objects, roughly estimated, are given, as, for instance, whether they are large, small, of moderate size, tall, short, wide, or narrow.

These rough measurements often help to distinguish objects, such as trees, fields, hedges, or houses, from one or more objects of a similar nature. Men are first practiced in completing the description of sections or areas of ground and features commenced by the instructor, and as progress is made they describe areas which are merely pointed out by the instructor.

21. Instruction in military terms provides an opportunity for training the men in the study of ground, with reference to defensive features, lines of approach, etc. This is of the greatest military importance. Therefore, while on this subject the instructors train the men to **recognize all features of military importance**, such as good defensive positions, good lines of approach, good halting places for attack, covered approaches, dead ground, obstacles, and good or dangerous cover. When the men have learned to recognize all features of military importance the instructor indicates an area of ground and questions each man of the squad as to what military features may be seen. The men then describe these military features in correct terms.

The men should also be taught simple geometrical terms, as round, square, conical, right angles, parallel, horizontal, vertical, perpendicular, etc., and such military terms as line, column, infantry, and cavalry, etc.

CHAPTER III.

THE THEORY OF FIRE.

22. The fire director works with a most powerful and flexible medium—the fire of the modern rifle. He should be a master of this medium, able to gauge its powers and to recognize its weakness. He must know when it is profitable to fire and when it is not profitable. He should know how to increase fire efficiency when necessary according to the particular local conditions surrounding a concrete case. All of which implies that he have a thorough knowledge of the theory of fire.

23. Definitions.—In the discussion of rifle fire the following terms are commonly used (see fig. 1):

(1) **Trajectory.**—The curve described by the bullet in its flight through the air—bdf. It is divided into the rising and falling branches, the highest point, called the summit, being the division. The distance of the summit from the muzzle of the rifle is a little greater than half the range.

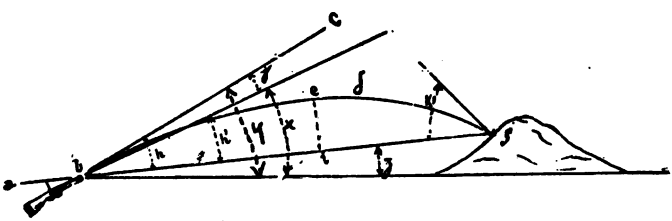


FIG. 1.

(2) **Range.**—The distance from the muzzle of the rifle to the target (*bf*).

(3) **Line of aim.**—The prolongation of the line of collimation established by the front and rear sights or by the telescopic sight.

(4) **Line of site.**—The imaginary line joining the target and the axis of the bore at the muzzle (*bf*).

(5) **Line of departure.**—The prolongation of the axis of the bore at the instant the bullet leaves the rifle (*bc*).

(6) **Angle of departure.**—The vertical angle between the line of departure and the line of site. It is the angle of elevation plus the jump.

(7) **Angle of elevation.**—The vertical angle between the line of site and the prolongation of the axis of the bore when the rifle is aimed (*h*).

(8) **Quadrant angle of departure.**—The vertical angle between the line of departure and a horizontal plane passing through the axis of the bore at the muzzle (*y*). It is the angle of departure plus the angle of site.

(9) **Quadrant angle of elevation.**—The vertical angle between the axis of the bore when the rifle is aimed and a horizontal plane passing through the axis of the bore at the muzzle (*x*). It is the angle of elevation plus the angle of site.

(10) **Angle of site.**—The vertical angle between the line of site and a horizontal plane passing through the axis of the bore at the muzzle (*z*).

(11) **Angle of fall.**—The vertical angle between the line of site and the tangent to the trajectory at the point of fall (*k*).

(12) **Jump.**—The vertical angle through which the barrel moves during the travel of the projectile from breech to muzzle (*j*). It is the difference between the angle of elevation and the angle of departure.

(13) **Point of impact.**—The point at which the bullet strikes (*f*).

(14) **Point of aim.**—The point at which the line of aim is or should be directed (*f*).

(15) **Initial velocity.**—The rate of speed of the bullet as it leaves the muzzle.

(16) **Remaining velocity.**—The velocity of the bullet at any point of the trajectory.

(17) **Plane of fire.**—The vertical plane containing the line of departure.

(18) **Drift.**—The departure of the bullet from the plane of fire.

(19) **Ordinate.**—The vertical distance between the trajectory and the line of sight. This distance is measured at any point in the flight of the projectile and on a line perpendicular to the line of sight.

(20) **Shot group.**—The pattern made on the target by all of the bullets fired by an individual or a body of men. If made on a vertical target, it is called a vertical shot group; if on a horizontal target, a horizontal shot group.

(21) The sheaf.—A cone containing all the trajectories of a series of shots. It is called an individual sheaf when the series of shots in the pattern has been fired by a single individual. It is called a collective sheaf when the pattern is the result of the collective firing of more than one individual.

(22) The rifling.—A gun barrel is said to be rifled when it has spiral grooves cut down the bore.

The rifling directly affects the trajectory, by enabling the elongated bullet to be used instead of the round ball of former days. The advantage of this bullet over the round ball is that the long pointed bullet has great weight in comparison to the surface directly offered to the air. The combination of the rifling and the long bullet also gives the bullet stability or steadiness of flight and increases the accuracy of the arm.

THE TRAJECTORY.

24. The curvature or shape of the trajectory is influenced by—

(1) The propelling force (explosion of the powder charge).

(2) Gravity.

(3) The resistance of the air.

25. (1) *The propelling force.*—The explosion of the charge drives the bullet forward and causes it to leave the muzzle with a very high rate of speed. This rate is called the initial velocity.

The service ammunition is loaded with a charge of powder which, when fired from a standard Springfield rifle with selected bullets and with the air at a temperature of 70° F. at the time of firing, gives a muzzle velocity of 2,700 feet per second. That is to say, this bullet would travel 2,700 feet in the first second if the rate of motion remained unchanged.

Due to unavoidable variations in manufacture, this standard initial velocity will vary by plus or minus (±) 20 foot-seconds (f. s.) even with the best ammunition.

Further variations in initial velocity are caused by variations in temperature, barometric pressure, and humidity.

For additional study of this subject the student is referred to Ordnance publication No. 1923, "Description of the United States magazine rifle."

26. (2) *Gravity.*—Gravity is the natural attraction which draws all unsupported bodies toward the center of the earth with ever-increasing speed. This attraction commences to act on the bullet the moment it leaves the muzzle of the rifle barrel.

The effect of the force of gravity is to change the path of the bullet from a straight to a curved line and finally bring it to the earth.

Elevation.—In order to allow for the fall of the bullet, owing to the force of gravity, it is necessary to direct the line of departure as much above the object to be hit as the bullet will fall below it in any given distance if the axis of the barrel is pointed at the mark. The rifle is provided with a sight which permits the soldier to keep in sight, while the muzzle of the barrel is elevated, the point that it is desired to hit.

Every soldier knows that elevating the muzzle of the rifle causes the bullet to go higher in the air and as a result go farther. This elevating the muzzle by raising the slide on the leaf sight and sighting at an object causes the bullet to leave the rifle not along the line of aim but above that line.

27. (3) *Resistance of the air.*—The bullet in its flight from the rifle to the target displaces the air in every direction; the resistance of the air offered to the displacement depends upon the shape of the bullet, its rate of motion, and the density of the air. It is much greater for those bullets having a high than a low velocity.

The effect of wind increases or decreases with its velocity and depends upon its direction. A side wind causes the bullet to move sideways, one blowing into the face of the firer increases the resistance of the air, and one blowing in the direction of the fire reduces the resistance.

Riflemen increase their elevation for—

(1) Ammunition of low velocity.
(2) High barometer.
(3) Low temperature.
(4) Dry weather.
(5) Bright sights and a dark target.
(6) Wind coming from the target.

They decrease it for—

(1) Ammunition of high velocity.
(2) Low barometer.
(3) High temperature.
(4) Damp weather.
(5) Dark sights and a bright target.
(6) Wind blowing toward target.

Under the combined effect of the propelling force, force of gravity, and the resistance of the air, the trajectory first rises above the horizontal with a scarcely perceptible curve to the summit, beyond which point it curves downward with ever-increasing curvature until it strikes the target or the ground. When the rear sight has been set at the proper elevation, and when the line of aim has been directed at the target, then, in theory, the firing of the rifle should result in the target being struck by the projectile, i. e., the points of aim and impact should coincide. Because of the numerous variations in conditions just discussed, this seldom if ever occurs in practice. The greater the skill of the marksman and the greater the perfection of the arm and its ammunition the more nearly will the results in practice approach the theoretical ideal.

OTHER FACTORS AFFECTING THE TRAJECTORY.

28. Angle of departure.—On account of the imperfections of the human eye, the line of aim of successive shots are not identical; that is, are not directed at the same spot (error in aiming). As a result of the shock of the discharge, the position of the axis of the bore changes, with reference to the line of site, at the moment that the bullet leaves the muzzle ("jump"), and the amount of this change varies with every shot. In addition to the jump and the errors in aiming are the errors in holding; that is, the errors which are caused by the firer's inability to keep the line of aim correctly directed at the moment of discharge and to avoid canting the piece or to maintain a uniform cant. These factors cause variations in the angles of departure of successive shots, and thus they account, in part, for the fact that no two shots, fired under seemingly identical conditions, strike the same point. Training in marksmanship reduces the amount of these variations to a minimum.

29. Sighting of rifles.—In the sighting of rifles a mean graduation for each range has been adopted, and a high standard of accuracy for all practical purposes is thus obtained. Each rifle is carefully tested before issue, but it must be understood that no two rifles behave in exactly the same manner, and that, if compensation could be made for every error in sighting of the rifle before issue, the wear of parts and the loosening and tightening of screws, etc., would bring about faults from time to time which would affect the shooting of each rifle differently.

30. Jump.—The rifle, when fired by the soldier, is not held in a rigid support but in an elastic one. This elasticity is found not only in the firer's body but also in the parts of the rifle itself. Acted upon by the force of recoil, there is a slight yielding of these various elastic elements which support the barrel, and this results in a movement of the barrel through a small vertical arc during the period of the travel of the projectile from breech to muzzle. This movement is termed the "jump" and is apart from and not to be confused with the vibration within the barrel itself, which is termed the "flip."

Jump may be either positive or negative, depending upon whether the angle of departure is greater or less than the angle of elevation.

31. Drift.—The drift of the bullet is the lateral deviation of the bullet after it has left the barrel. This drift is to the right and is due to the right-hand rifling of the barrel, which causes the bullet to twist in that direction. The drift is automatically corrected by the rear sight.

32. Fixing the bayonet.—Fixing the bayonet to the rifle affects the trajectory by checking with its weight the jump of the rifle. This is why, with the bayonet fixed, the shot is usually low. With the bayonet fixed it is necessary to increase the elevation about 50 yards.

33. Rests.—For practical purposes the shooting of the rifle is not affected by resting the muzzle or any portion of the stock lightly on earth or other substance. If, however, a rest is used for two successive shots it should be applied at the same point for each shot, or the points of strike will be different.

35. Rigidity of the trajectory.—According to the principle of the rigidity of the trajectory the relations existing between the trajectory and the line representing the range are sensibly the same whether the range be horizontal or inclined to the horizon provided that the quadrant angle of departure (y, fig. 1) is small. That is to say, considering the angle made by the line of departure with the horizontal (quadrant angle of departure), as small, in figure 1, if the trajectory bdf and the range bf were revolved about the point b until bf were horizontal the relation of the trajectory to bf would not change. A trajectory calculated for a horizontal range equal to bf would then answer as the trajectory for the actual inclined range bf.

THE SHEAF.

36. The bullets from two successive shots fired from a rifle under seemingly identical conditions (i. e., the same sight setting, the same aiming point, the same weather conditions, and the same hold) will, after leaving the muzzle of the rifle, travel a different path or trajectory. The amount of the difference between these trajectories will depend upon—

(1) The accuracy of the rifle itself.

(2) The ammunition.

(3) The error in aiming.

(4) The difference in holding.

(5) The change in atmospheric conditions.

It therefore follows that the bullets do not hit at exactly the same spot.

If one rifle be fired a great number of times there results a great number of trajectories forming a cone analogous to a stream of water from a hose. At the muzzle all the bullets pass through the same point. This cone is called the individual sheaf. A number of individual sheafs is called the collective sheaf, usually termed the sheaf.

The intercept of the sheaf on a vertical surface is called the vertical-shot group; that on a horizontal surface a horizontal-shot group.

The central point about which the projectiles group themselves is the center of impact.

There is an imaginary curve which occupies a mean position among all these trajectories. It is called the mean trajectory, and is that which the bullet would probably have followed had the causes of deviation not existed. All ordinates are computed to this mean trajectory, and also it is the basis for the computation of the angles of fall and departure.

The relation between the vertical and horizontal shot groups may be expressed in quite rough approximation, thus: The height of the vertical-shot group is equal to the depth of the horizontal-shot group multiplied by the natural tangent of the angle of fall, and the depth of the horizontal-shot group is equal to the height of the vertical-shot group multiplied by the natural cotangent of the angle of fall.

37. When a number of marksmen fire either simultaneously or "at will" with the same point of aim and the same elevation the bullets will form a vertical-shot group having the

general shape of an ellipse, with its major axis vertical, and will be symetrically grouped about the center of impact—not necessarily about the point of aim. They will be grouped more densely near the center of impact than at the edges, and at ranges less than 1,000 yards one-half of all the shots will be found in a strip about one-fourth of the size of the whole group.

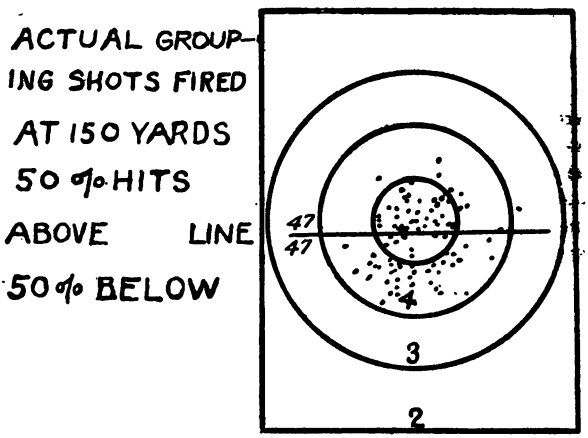


FIG. 2.

Thus if the whole group is found to be, say, 40 inches high, then a strip about 10 inches wide placed so that about 5 inches lie on each side of the center of impact will contain 50 per cent of all hits.

The width of a central strip containing 50 per cent of all the hits of any shot group is called the "mean or 50 per cent dispersion." This may be vertical, lateral, or longitudinal.

As the range is increased beyond 1,000 yards the feature of the dense grouping of the bulk of the shots about the center of impact begins to disappear. The greater the range the more nearly does the pattern show an equal distribution of shots throughout the entire group; i. e., it approaches this equal distribution as a limit. In theory this limit would be reached at a range of infinity. In practice the approach to this limit is denied beyond a distance of 4,891.6 yards, the extreme range of the rifle.

With an equal distribution of shots throughout the pattern, 50 per cent of these shots would be contained in a central strip that was half the height of the entire group, and similarly 75 per cent of the shots would be contained in a strip three-quarters the size of the whole group.

Test firing shows the following results:

At 1,000 yards the 75 per cent zone measured 47 per cent of the entire group.

At 2,000 yards the 75 per cent zone measured 54 per cent of the entire group.

At 2,900 yards the 75 per cent zone measured 60 per cent of the entire group.

38. The greater the skill of the marksman and the more perfect the rifle and the ammunition the smaller the dispersion. Hence the Ordnance Department is concerned in increasing the accuracy of the rifle and ammunition while the troop leader is interested in increasing the skill of the soldier in shooting.

The soldier is taught to aim, hold, and shoot accurately, so as to make as small a shot group as possible, and the officer is taught how to direct the corresponding sheaf so as to assure the highest returns in hits.

It is the collective fire of masses of men that must occupy the attention of the officer in war.

39. All inquiry into the effect of fire is based upon a thorough understanding of the cone of dispersion of fire, for any conclusion reached as to the influence of this or that modifying factor on the efficacy of fire must be based either upon a long and carefully prepared series of experimental firings or upon the theory of probabilities as applicable to known dispersions. Theoretical results have been amply verified by actual firing, and the student may be assured that in studying the theory of fire he has not made the mistake of departing from things which are real and practical.

It is not necessary to explain the mathematical principles involved in these computations; it is sufficient for present purposes to know that probable effects can be foretold and that by foretelling the results in two contrasting cases the value of any given influence on shooting can be ascertained.

In order that comparisons in shooting may be made, in order that the influence of an incorrect elevation may be demonstrated, and for other and analogous reasons, the whole subject of war shooting is based upon an understanding of dispersions, mis-

placed centers of impact, densities, and such fundamental principles.

Tables of fire have been constructed from which it is possible to calculate the number of hits expected on a target of given dimensions with a certain class of marksmen at any given range. These tables are ordinarily used as standards of comparison for judging results in field firings.

DANGER SPACE.

40. Danger space is defined by the Small-Arms Firing Manual as being the sum of the distances in the path of the bullet in which an object of given height will be struck.

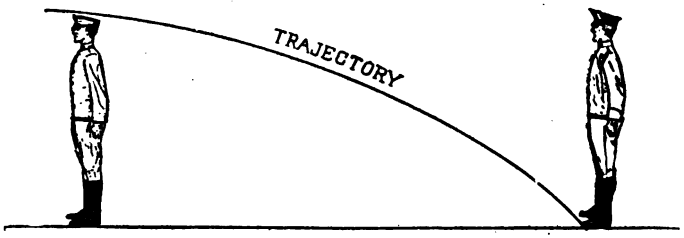
If a man in the standing position fire a rifle with a horizontal line of aim, it is evident that for a certain distance in front of the muzzle another man may be hit by the bullet while it is in the rising branch of the trajectory. If the muzzle is at a height of 56 inches from the ground, and the height of the man standing is 68 inches, then it will be dangerous for a man to stand anywhere in the line of fire between the muzzle and the point where the bullet in its upward flight rises above the head of the man (68 inches).

Since the line of sight is 56 inches above the ground, the trajectory will be 68 inches above the ground when it has risen 12 inches above the line of aim. If the firer is using a great angle of elevation, the trajectory will rise to a height of 12 inches above the line of aim in a rather short distance; if, on the other hand, the angle of elevation is small, the bullet will travel so nearly horizontal that it will not attain the 12 inches in a very great distance, if at all.

Whatever this distance is in front of the muzzle within which the bullet does not rise higher than the object, it is called the danger space of the rising branch of the trajectory. If the firer is shooting from a prone position, so that the muzzle, instead of being 56 inches from the ground, is only 12 inches, then the space would be dangerous for a standing man the entire distance from the muzzle to a point where the trajectory rises 68 minus 12 inches equals 56 inches above the line of aim.

The danger space for a mounted man is, obviously, greater than for a man lying down, and so in each case it is necessary to know all the conditions before the table of danger spaces, as published by the Ordnance Department, can be of any value.

41. In the falling branch of the trajectory is another danger space analogous to that just discussed, and, like that, dependent upon certain conditions of fire, line of aim, and the height of the object for which the space is dangerous.



DANGER-SPACE

FIG. 3.

In figure 3, if the point of aim is taken at the head of a standing man, all the danger space is in rear of the target. If, on the other hand, aim be taken at the foot of the target, the entire danger space is in front of the target.

If the point of aim is at the middle of the object fired at, part of the danger space will be in front of the target and part in rear.

By using an elevation of 700 yards against the middle point of a cavalryman 8 feet high, the danger space extends from the firer to 801.5 yards. Against an infantryman, on the other hand, it extends from the 586.8-yard point (high strike) to 772.6 yards (ground strike), or a total distance of 185.8 yards.

If the point of aim is taken at the bottom of the target in the foregoing cases, it is 700 yards long in each case—a noticeable gain in the latter case but a loss in the case of the cavalryman.

42. The term "danger space" is not to be confused with the term "beaten zone," which means the intersection of the cone of dispersion (or sheaf) with the surface on which the objective of the fire stands or the space on the ground in which the bullets strike in a series of shots fired by a body of soldiers with the same aiming point and the same rear sight setting.

Swept space is the danger space as modified by the ground slopes.

In dealing with danger spaces it is usual to distinguish between the **danger space** and the **swept space**, both of which are functions of the mean trajectory, and between these and the

dangerous zone, which is a function of the whole or a part of the cone of fire.

It will be observed that for a given height of target and point of aim the danger space is of fixed dimensions at the several ranges, while the swept space varies in addition with the slope of the ground, being shorter on rising ground and longer on falling ground than the danger space, and all the functions of the dangerous zone, such as the density of the group at given distances from the center of impact, etc., are correspondingly modified.

43. The fire controller must remember that the danger space under 700 yards is affected by the position of the firer (height of muzzle from the ground), the danger space increasing as the height of the muzzle decreases. At the longer ranges no material effect is felt from the different positions of the firer due to the increased angle of fall.

The Ordnance Department publishes a table of danger spaces calculated under the assumption that the gun when fired is 12 inches above the ground, that the height of a man is 68 inches, that the head of a man on horseback is 8 feet above the ground, and that the point of aim is at the center of the target.

Under these conditions the total dangerous spaces for infantry and cavalry at the various ranges are given as follows:

Range.	Infantry.	Cavalry.
100	680.9	468.3
200	547.3	666.5
300	540.4	676.8
400	572.9	633.7
500	628.3	670.5
600	696.7	731.9
700	420.8	801.5
800	301.8	473.8
900	233.7	352.6
1,000	187.2	275.3

EFFECT OF SLOPES AND SITES.

44. The influence of the ground on fire effect is manifested by a modification of the depth beaten and grazed by the cone of collective fire. This depth decreases if the surface of reception rises, and increases if the surface of reception falls with respect to the line of site.

The effect of slopes and sites on the efficacy of fire is so important that it is essential for all officers and noncommis-

sioned officers to understand thoroughly the probabilities of fire effect as increased or diminished by the inclination of the ground with respect to the line of site.

In the attack, such information will guide them in adopting suitable formations and directing the fire of their organizations to the best advantage.

In defense such knowledge will assist them in the selections of the best firing position, at the same time enabling them to take the necessary steps to minimize the inherent disadvantages of these fire positions.

Only plane surfaces without undulations or accidents are here considered.

45. There are three general cases to be considered:

(1) When the ground rises with respect to the line of site.

(2) When the ground is level.

(3) When the slope is falling with reference to the line of site.

In case 1 (fig. 4) the sheaf covers a space of 1 inch on the slope B–C. In case 2 the same sheaf on level ground covers 1¾ inches, while in case 3 it covers 2¾ inches.

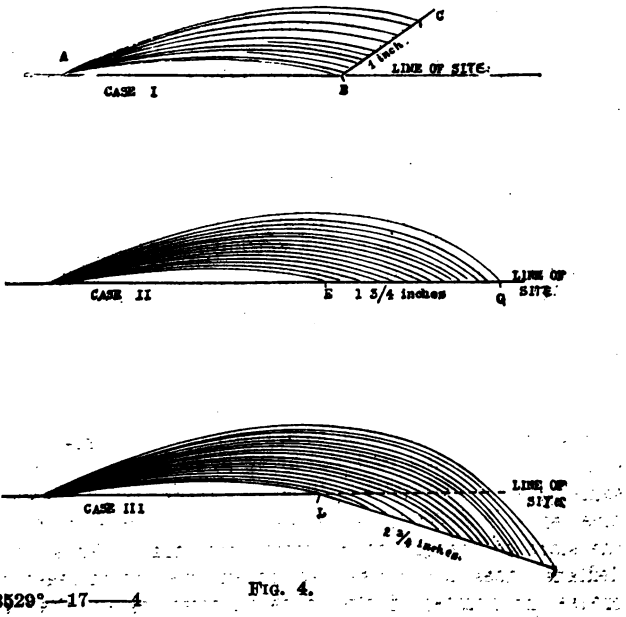


FIG. 4.

46. The simple equation by means of which the effect of slopes and sites upon the longitudinal (or horizontal) dispersion may be calculated, knowing the longitudinal, is for rising ground $S=d\frac{f}{f+g}$ and for falling ground, $S=d\frac{f}{f-g}$.

Where g is greater than f there is a dead space,

In which S=Dispersion as influenced by the slope,

d=Depth of longitudinal dispersion, or swept space,

f=Angle of fall of the trajectory, and

g=Angle of slope of the ground.

The angle g is the vertical angle between the plane which receives the impact of the shot group and the prolongation of the line of site. In case 1 this angle is positive, in case 2 it is zero, and in case 3 it is negative.

Example: At 1,000 yards the depth of the mean (50 per cent) beaten zone on level ground is approximately 106 yards and the angle of fall approximately 1½°.

Assuming that the ground rises 1° with reference to the line of site, then—

$$S=\frac{106\times 1\frac{1}{2}}{1\frac{1}{2}+1}=63.6$$

Assuming that the ground falls 1° with reference to the line of site, then—

$$S=\frac{106\times 1\frac{1}{2}}{1\frac{1}{2}-1}=318$$

46½. The influence of slopes upon the depth of beaten zones must not be confused with the influence of those same slopes upon the probable number of hits that may be expected.

When firing at a linear target, i. e., at a hostile formation that has no depth (such as a skirmish line), a given error in the determination of the range may be expected to be productive of the same reduction in hits no matter whether the ground be rising, falling, or level with respect to the line of site—this with the proviso that the target is not defiladed in any case; that the range, the angle of departure, the direction of the line of aim in reference to the target, and the conditions of light and atmosphere are identical in each case; that the same number of shots are fired; and that the firing in each case results in the same vertical dispersion. In other words, for a given sheaf directed at a given linear target with a given error in range, the slope of the ground on which the target stands (barring defilade) does not in itself act in any way to increase or decrease the number of hits to be expected, except that at the

shorter ranges there usually will be a greater percentage of ricochets on level and falling ground than on rising ground.

Certain authors whose writings on musketry have been accepted in the past as authoritative have advanced the argument that as the depth of beaten zone was decreased on rising ground, then for a given error in estimating the range it would be necessary to resort to combined sights to insure effect on the target when it stood on rising ground, whereas a single elevation would suffice to secure the same effect if the only change in conditions were the placing of the target on level ground.

When there is depth to the hostile formation, e. g., when the target is a column, then rising ground would have the effect of reducing the amount of the column that will be covered by a given sheaf, while falling ground would result in a greater portion of the target being covered by the same sheaf.

For example, assume that the target is a column, *AB*, and that fire is directed upon the head of the column from *C* with an error of *AD* in range:

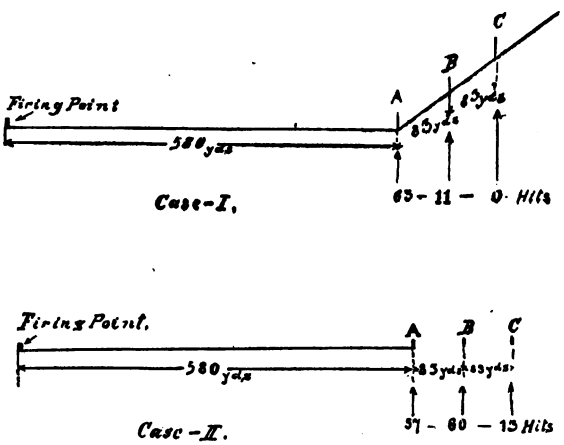


FIG. 5.

Let *CA* be the line of site, *CMM* be the mean trajectory, *CVV* be the upper limit of the 75 per cent zone, and *CLL* be the lower limit of the 75 per cent zone.

By reference to the figure it is readily seen that when the column is on rising ground, *RAR*, only about one-fourth of the

column is under fire; on level ground, *DAB*, about one-half of the column is under fire; while on falling ground, *FAF*, all of the column is under fire.

But it will be noted also that the changes in ground slope do not effect any change in the position of the linear element *A*, at the head of the column, with reference to the mean trajectory. Hence, barring ricochets, the percentage of hits to be expected on the head of the column would be the same in any of the three cases noted.

From this comes the principle that ground slopes affect hits only in those portions of the target that are in front or in rear of the line at which the fire is directed.

47. The mistake must not be made of assuming that reverse slopes are safe because out of sight, and that the formation to adopt behind crests is the line of skirmishers. This false assumption has cost many lives in battle.

As an illustration of the effect of fire against a line of skirmishers on the reverse slope of a hill may be mentioned a fire problem conducted at the School of Musketry in which the targets were invisible to the firers.

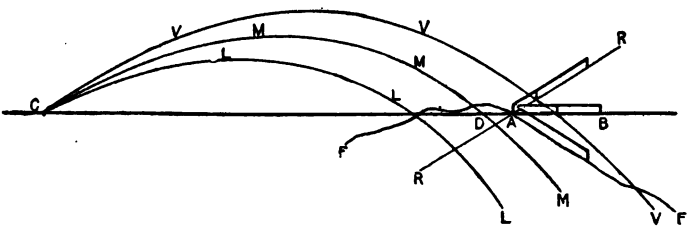


FIG. 6.

A skirmish line of 127 kneeling figures on a 1° reverse slope 50 yards in rear of the aiming point, on the crest, received 251 hits on 97 figures. Again, out of a total of 2,429 shots fired by a company of 122 men at a range of 900 yards in the same problem, 116 figures out of the 127 were hit.

48. The following demonstration at the School of Musketry during the special course for noncommissioned officers, 1915, shows in a very graphic manner the difference in firing at targets on a slightly rising slope and level ground.

Object.—To illustrate the influence on the beaten zone of ground rising with respect to the line of sight and the scope of a single sight setting when the ground is favorable.

Method.—(1) A platoon of 24 men fired a series of 10 shots per man with a sight setting of 580 yards and aiming at target A.

(2) Same sight setting and aiming at target A, firing same number of rounds as in first case.

Target.—(1) Three board targets (wall), each 48 feet long. 2 feet high, placed on a 3½° slope, in column at distances of 85 yards (case 1, fig. 5).

Results.—First case—rising slope, 63 hits, target A; 11 hits, target B; none, target C.

Target.—(2) Same target, case 2, figure 5, level.

Result.—Second case—level ground, 57 hits, target A; 60 hits, target B; 13 hits, target C.

From the foregoing, certain well-defined conclusions may be drawn with reference to the utilization of ground slopes.

49. On ground rising with respect to the line of sight the supports and reserves may be placed closer to the firing line than on level ground, so far as danger from fire directed on the first line is concerned. The steeper the slope the closer in they may be.

On falling slopes the supports and reserves must be farther back than on level ground except when the slope exceeds the angle of fall enough to give a defiladed space nearer the firing line.

A knowledge of angles of fall, of slopes and of their relation to each other are of great importance to leaders of fighting men. The ostrichlike tendency to think the supports secure from fire because the enemy can not see them must be overcome.

No one is expected to work out on the ground the formulæ for reduction of dispersions to different slopes, but it can be remembered that the effective (75 per cent) depth of beaten zone at 300 yards extends from the muzzle to 500 yards; at 1,000 yards it is reduced to about 200 yards in depth; at a range of about 1,500 yards it is reduced to about 150 yards, and there remains until a range of about 2,000 yards is reached; beyond 2,000 yards the depth increases, reaching a depth of 200 yards again at a range of 2,700 yards.

50. Ricochets.—The modern bullet, with its elongated form, tends to tumble on striking even slight objects. They ricochet most frequently on water, on rocky and hard ground, more rarely on wet meadows and on tilled soil, but they do not ricochet at all on sandy soil. Ploughed fields in which the furrows run obliquely to the line of fire eliminate ricochets.

The number of ricochets depends on many elements, such as the character of the surface of the strike, its slope, and the mass and shape of the bullet, as well as the range and the accuracy of fire. At long ranges the angle of fall becomes great enough to reduce the number.

Untrained men, many of whose shots strike close to the firing point, increase the number of ricochets beyond the average, which is generally accepted as about 16 per cent.

Usually a small-arm projectile is deflected on ricocheting to the right of the plane of fire, apparently due to the twist of the bullet in flight. Sometimes, due to favorable irregularities of the ground, this deflection may amount to 30° when the limit of the range will not exceed 1,500 yards. The range of the ricochet may be as great as 2,700 yards. Certain experiments in France, when firing at 800 meters (874.9 yards), gave 4 per cent of the ricochets on targets the height of a man at 1,400 meters (1,531.09 yards) and 1 per cent on similar targets placed at 1,850 meters (2,023.21 yards).

The effect of ricochets is such that in the occupation of a defensive position due consideration should be given to the nature of the ground immediately in front of the line of trenches, with a view to eliminating as much as possible the effect of ricochets, thus adding to the essentials of an ideal defensive position, which is never found, another item to be included in the final compromise location of the trenches.

THE INFLUENCE OF THE POINT OF AIM.

51. The effectiveness of the shot group or sheaf is directly dependent, other conditions being equal, upon the point of aim used in any particular firing.

Under the head of danger space it has been pointed out that if aim be taken at the head of the enemy the danger space will lie in rear of him, while if it be taken at the middle of the figure the danger space will lie partly in rear and partly in front of the target. If aim be taken at the foot of the target all the danger space will lie in front of it (fig. 3).

If an enemy is advancing, aim should be taken at his feet, because he will then be walking into the danger space. On the other hand, if the enemy were running away, by the same token aim should be at his head.

As a rule men in action will not alter their sights at the close ranges, say, under 400 yards.

It is also believed to be an accepted fact that in the heat of action men will unconsciously take more front sight than they will in peace practice on the target range.

Soldiers of practically all nations are taught to aim at the feet or bottom line of the target for the following reasons:

(1) The line of sight inclines more and more toward the ground as the enemy gets nearer.

When aim is taken at the middle of an object this result is not obtained in the kneeling and prone positions. In fact the line of sight is horizontal if the firer is kneeling, because the height of the origin is the same as the point aimed at, while when the firer is lying down it rises as the objective approaches (the height of the origin being below the point of aim).

Moreover, the position of the shot group does not depend on the height of the origin of fire.

(2) It gives a more advantageous position to the shot group and makes the zone grazed by the whole cone longer.

(3) The ricochets from the lower half of the sheaf are effective.

(4) When aim is taken at the middle of the object, if a shot is fired with a little too much elevation, or if too much of the front sight is used the bullet may pass above the head of a standing man. This is avoided by aiming at the bottom of the target.

(5) The front sight which covers about half the height of a man standing when the latter is at a distance of 200 yards is not so likely to hide the object from view.

With small objects, such as a trench where only a line of heads is visible, if aim be not taken at the bottom edge of the line of heads the front sight is likely to obscure the target in such manner that the soldier will get few hits.

(6) The lower edge of a line of figures, be they only heads or prone figures, furnishes a more distinct aiming point than does the top edge of the target.

COMBINED SIGHTS.

(Par. 217, S. A. F. M.)

52. Combined sights is the simultaneous use of two or more sight settings in order to increase the depth of the beaten zone.

The object of combined sights is to compensate for an error in the determination of the range and to increase the probability

of hitting the target. Such fire loses in concentration and hence must be offset by an increase in volume.

The two problems connected with the use of combined sights are—

(1) At what range should they first be used?

(2) What should be the difference in sight setting?

In theory, combined sights are employed when the probable error in the determination of the range exceeds half the depth of the effective (75 per cent) beaten zone. The number of sights to be employed is found by dividing twice the probable error in range by the depth of the 75 per cent beaten zone, any fraction in the quotient being considered as 1.

Lacking an instrument or table for determining the exact depths of beaten zones at given ranges, the fire director may accept this rule of thumb as giving fairly satisfactory results. The rule is as follows: Between 1,000 and 2,700 yards the depth of the effective (75 per cent) beaten zone of average shots is 150 yards; at ranges less than 1,000 yards or greater than 2,700 yards the depth of this same zone is 200 yards.

In using combined sights the elevations employed should differ from each other by an amount equal to the depth of the 75 per cent beaten zone, the center of the resulting-shot group being at the estimated range. For example, assuming a 10 per cent error and an estimated range of 1,400 yards, the total zone to be covered would be 280 yards. The depth of beaten zone being taken at 150 yards, then 150 is contained twice in 280, and hence two elevations should be used. As these elevations are to differ by 150 yards, and as the resulting-shot group is to be centered at the estimated range (1,400 yards), then one elevation should be 75 yards less than 1,400, and the other 75 yards more than 1,400, i. e., 1,325 and 1,475 are the elevations to be used.

In like manner, assuming a 10 per cent error and an estimated range of 1,700 yards, the elevations required are found to be 1,550, 1,700, and 1,850.

53. When the range is known combined sights are not used.

(Combined sights are not used by a force of less strength than two platoons.) Paragraph 217, S. A. F. M., says, "The expedient will not usually be employed by bodies of less strength than a battalion." This statement apparently applies only to fire of position at the extreme ranges.

54. In the average company, and considering a probable error of 10 per cent in the determination of the range and also that the tactical situation demands that a given target be taken under fire, then combined sights should be used to compensate for this 10 per cent error as follows: Two elevations at ranges greater than 1,000 yards, three elevations at ranges greater than 1,500 yards, and four elevations at ranges greater than 2,300 yards.

These limiting ranges would be increased if the marksmanship fell below the average or if there was a greater precision in the determination of the range; they would be decreased when the marksmanship was better than the average and when the probable error in range was greater than 10 per cent.

The use of combined sights to compensate for probable errors in range must not be confused with their use to secure distribution in depth on a column formation. In the latter case the ranges at which combined sights are necessary and the number of elevations required would depend upon the depth of the target and slope of the ground on which it stood.

THE BATTLE SIGHT.

55. The setting of the rear sight when the leaf is down is termed the "battle sight." In theory this sight corresponds to an elevation of 547 yards. In practice it is found that the average battle sight when used by troops corresponds to an elevation of about 436 yards.

It is not good practice to consider that the battle sight must be used at all ranges within its zone, i. e., at all ranges less than 436 yards. The correct use of the battle sight is in emergencies when, for any reason, it is impossible to use the leaf sight with greater accuracy.

Examples of a correct use of the battle sight would be when the vulnerable surface of the target is so large, and it is at such close range that errors in sight setting of even several hundred yards would have no tendency to reduce the effect of the fire; when the target is fleeting and time is lacking in which to estimate the range and set the leaf sight accordingly, the situation demanding fire of some effect instantly even though that effect be moral only and not physical; and when the morale of the troops has been reduced to such an extent as to preclude the idea of accurate sight setting.

The greatest depth of zone will be obtained with the battle sight if the soldier is taught to aim always at the breast of the enemy irrespective of whether the enemy be mounted or dismounted and, in the latter case, irrespective of his posture—standing, kneeling, sitting, or prone.

CHAPTER IV.

INSTRUMENTS.

57. Certain instruments are necessary for the proper observation and control of the fire of modern arms. These are

The range finder.
The field glass.
The musketry rule.

Conditions of field service require that these instruments be rugged in construction and simple to use. In general, the field glass is required for observation of the terrain and the effect of fire; some form of instrument, such as the mil scale, is required for determining angles; and the range finder is required, or at least desirable, for determining ranges.

THE RANGE FINDER (see par. 121).

58. Field glasses.—The binocular glass, consisting of two complete optical systems, connected by a rigid or hinged frame, is universally used for military purposes. However, if one of the two optical systems should be damaged, or if parallelism of the two systems should be destroyed by accident to the frame or displacement of the lenses or prisms, it is well to remember that the field glass can still be used effectively as a monocular.

The two types of field glasses in common use are the Galilean glass and the Porro prism glass.

59. The Galilean glass.—The Galilean glass has convex objectives and concave eyepieces. It is of low power (magnifying from 2 to 5 diameters) and is a comparatively inexpensive instrument. The type A and type B glasses of the Signal Corps are examples of this form of field glass. Figure 7 shows diagramatically the arrangement of lenses in the Galilean glass.

In this field glass the rays from an object are converged by the object glass (*O*) and would normally focus at the focal plane (*C*) and there form the inverted image *b*—*a* were it not that the double concave eyeglass or ocular (*D*) is so located in the barrel of the glass as to intercept the pencils before they are focused. This double concave eyeglass diverges these pencils and forms a magnified erect image *a*—*b* apparently at E.

Due to the diverging action of the concave eye lens the cone of the pencils entering the eye is larger than the pupil of the eye, and therefore but a small part of the field gathered by the the object glass is utilized, which causes field glasses of this type to have a comparatively small field of view.

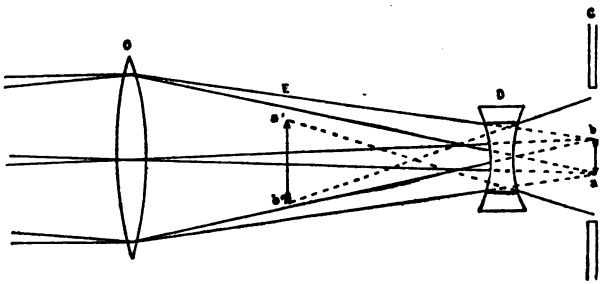


FIG. 7.

In the Galilean type of field glass the two optical systems are usually mounted rigidly and a single focusing screw moves both eyepieces in or out for adjustment of the focus only. The concave-eyepiece lenses are quite large, and for ordinary eyes accurate adjustment for interpupillary distance is therefore unnecessary. This means that the two lens tubes do not have to be hinged so that their distance apart can be adjusted to correspond with the distance apart of the pupils of the eye.

The optical principle of the Galilean glass makes it necessary to change the focus for maximum enlargement when viewing objects at different distances unless both objects are at a distance of several hundred yards from the observer. With this glass the eye, by being trained, can get a temporary focus with wrong adjustment of the eyepieces; but this is very hard on the eyes, and the glass may seem to go out of focus after a time because of eye fatigue and inability to keep up the strain. For this reason the focusing of the Galilean glass should be done carefully.

60. To focus the Galilean glass.—Start with the eyepiece well in, turn the focusing screw until the field is in apparent focus, and then go on beyond about one turn of the screw. Then very slowly turn the screw back until the focus is obtained again. If the glass is the personal property of the user, it is well to put a mark on the barrel corresponding to the correct focus for a range of about 500 yards. It will then be correct for everything beyond that distance. If the user's eyes have marked different optical characteristics, so that the broad focus of this type of glass will not be approximately correct for each eye, he should get a glass of the prism type with separately adjusted eyepieces. However, there are glasses of the Galilean type, of foreign manufacture, with interpupillary adjustment and separately adjustable eyepieces.

61. The Porro prism glass.—The Porro prism glass has convex objectives and eyepieces and prisms for erecting the image and shortening the length of the glass. It can be built of the highest powers and has a practically universal focus.

In the astronomical telescope, which consists simply of a convex object glass and a smaller convex eyepiece, the image is magnified but inverted. It is possible to erect this image by a system of erecting lenses, but this increases the length of the telescope and usually decreases the brilliancy of the image and the clearness of definition.

In 1850 Porro, a French engineer, discovered a combination of two prisms which, when inserted between the object glass and eyepiece of an astronomical telescope, showed the image erect or in its natural position. These prisms have an additional advantage—the ray is twice turned upon itself, and the telescope can in consequence be shortened. Figure 8 shows the path of rays through the prisms.

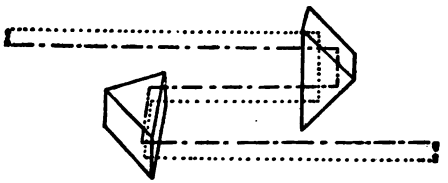


FIG. 8.

62. The Porro prism glass has two advantages inherent in the astronomical telescope. It is possible to get a large magnifying power combined with a large field of view. In addition, by

the use of prisms, the glass can be reduced in size to very small dimensions. This alone makes it the ideal glass for military purposes. The Signal Corps furnishes four glasses of this type, viz, type C, 10 power; type D, 8 power; type E, 6 power; and type EE, similar to type E, but equipped with a mil scale in the field and with other constructional refinements. A special sight scale in addition to the mil scale has been applied to the type EE glass (par. 74, fig. 10).

The glasses of the prismatic type are usually built with a jointed frame which permits of an adjustment so that the distance between the optical axes of the eyepieces can be made exactly that of the distance between the pupils of the user's eyes. There is a scale at the joint with figures 60 and 70 and intermediate divisions. The normal interpupillary distance is about 64 millimeters (2½ inches) and this scale shows the distance between the optical axes of the eyepieces in millimeters. Many glasses have an adjustment ratchet or stop which drops into a notch, and being once set for a certain interpupillary distance the glass can be opened until the stop drops into its notch and the interpupillary distance will be correct for the user.

63. To determine interpupillary distance.—Point the glass at the sky and open and close the joint until the field ceases to be two overlapping circles and appears to be one sharply defined circle. The interpupillary distance can then be read in millimeters from the scale at the joint. If one knows this constant for his eyes, he can at once set it off on the joint scale of a strange pair of glasses; otherwise the determination must always be made and the glasses adjusted for interpupillary distance before attempting to use strange glasses.

64. To focus the eyepiece.—All prism glasses have independent focusing arrangements for each eyepiece. In some types both eyepieces focus with one screw, and, in addition, one of the eyepieces has an independent adjustment. In other types each eyepiece is independently adjustable and there is no common adjusting screw. An index is generally engraved on the barrel and the eyepiece screws in and out, a scale with a middle zero being engraved on its circumference. Each division of the scale corresponds to a movement in or out of one-third millimeter, the movement outward or lengthening the focus being indicated as +, and the opposite movement being indicated as −. For a person with normal eyes a prism glass with eyepiece scales set at 0 is

in focus for everything between about 50 feet and infinity. If the eyes are not normal, or, in any case, with a new glass, each optical system should be focused separately on some object several hundred yards distant after the interpupillary distance has been carefully determined and adjusted. If the glass has the common ajusting screw and scale on but one eyepiece the eyepiece without the scale should be focused first and then the other eyepiece adjusted by turning it without touching the common adjusting screw.

Anyone with one or both eyes abnormal may instantly focus any prism glass if he remembers and sets off on the eyepiece scales the same readings that he uses on his own glasses.

65. Characteristics of a good field glass.—The standards for comparison of field glasses are based on the capabilities of the unaided normal human eye. There are four properties, measurable by these standards, that every field glass has, viz, power, light, field, and definition.

66. Power.—The power of a field glass is defined as the ratio of the diameter of an object as seen through the glass to the diameter as seen by the unaided eye.

The power of a field glass can be determined with sufficient accuracy by focusing the instrument on a wall, or, preferably, a range rod at least 200 yards distant. By looking at the object through the instrument with one eye and at the same time viewing the object with the other unaided eye it is possible to make a comparison of the apparent length or height of the two images. The ratio of the two is the power of the glass.

The actual power of most glasses varies more or less from the power marked thereon, but it is on cheap glasses that the greatest discrepancy is found.

For the mounted man a glass of but 4, or at most 6, powers can be used to advantage; on foot, with free hand, instruments of not to exceed 10 powers can be used. If more than 10 powers are desired, a holder or tripod becomes necessary, and if the holder is intended to be portable a greater power than 30 is not practicable, as the movements of the air or the slightest touch of the hands sets up vibration that renders clear vision impossible.

67. Light.—The illumination of an object when observed with the unaided eye is impressed upon the retina with a brightness in strict proportion to that of the object itself. If an object be viewed under equal illuminating conditions alternately with the

unaided eye and with a glass, the brightness of the object seen with the naked eye may be represented by 1, while that of the image in the glass will generally differ, being more or less bright. Light is a function of the dimensions of the object glass, of the power of the instrument, and of the dimensions and character of the media, such as prisms or erecting lenses, interposed between the object glass and the eyepiece. There is no easy method of measuring this property except with special instruments, but in glasses of the same general type the light varies directly as the square of the effective diameter of the object glass and inversely as the square of the power.

68. Field.—The field of the human eye for perception only is at least 90°, but for *distinct* vision it is much smaller, say, 45°.

The field of a field glass is always smaller and is, in any but very inferior glasses, sharply defined and capable of exact measurement. To measure the field of a glass, stake out a T on any convenient ground. The stem of the T is, for convenience in obtaining results without calculation, laid out 1,000 feet in length.

Figure 9 shows the arrangement and dimensions of the T in conventional perspective.

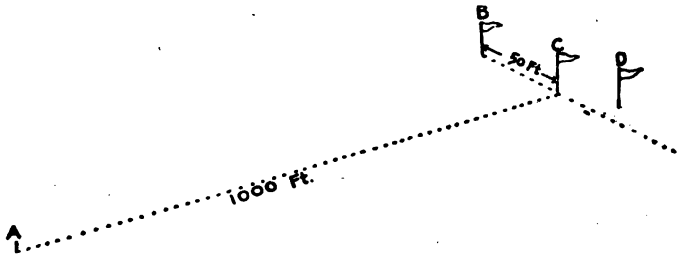


FIG. 9.

The observer with the glass stands at A and holds the glass so that the pole B is just visible at the left-hand edge of the field. An assistant moves pole D until the observer notes that it is just visible on the right-hand edge of the field. The assistant is then signaled to halt and make any fine adjustments of the position of the pole D as signaled from A. The assistant keeps pole D lined in on poles B and C. The distance B D is then measured with a tape in feet and is the field of the glass in feet at 1,000 feet or in yards at 1,000 yards

or in mils. If the distance B C is laid out exactly 50 feet, the distance C D+50 feet equals B D. If it is desired to reduce the value to angular measure, we may use the formula

$$\frac{BD}{2AC}=\tan \tfrac{1}{2} \text{ "Visual angle."}$$

69. The most important and essential quality of a field glass, and the quality most frequently neglected in choosing a glass, is definition; that is, the sharpness, the clearness, and the purity of the images seen through it.

To obtain good definition it is necessary that spherical and chromatic aberration be overcome, that the polish of the lenses be as perfect as possible, that the lens cement possess no inequalities, that the lenses (and prisms, if any) be well focused and rigidly mounted with reference to one another, and, generally, that the instrument be without optical defect.

Faults in this direction are discovered at once by examination of definition, whereas in determining the other constants they are hardly noticeable. In comparing the definition of any two instruments it is ordinarily necessary only to scan distant objects and observe to what extent details may be distinguished.

The following test may be used: Focus on printed matter at a distance just beyond that at which perfect clearness is given and gradually approach until the letters are distinctly defined. The instrument with which the print can be read at the greatest distance has the best definition.

70. Suggestions for the use of glasses in the field.—The strain upon the eye unaccustomed to the use of field glasses is very severe, and without proper training the advantage to be gained by using the glass is almost negligible. Therefore frequent practice in observation, using the field glass, is necessary to insure proficiency.

In using the glasses they should be securely focused at all times and should be held with both hands, pressed firmly enough to the eye sockets to keep the relation with the eyes constant but not so tight as to impress on them the beating of the pulse or the bodily tremors.

It must be remembered that when using glasses the eye is looking through a microscope at a small image of the distant object, and that it is very tiresome. Using glasses incorrectly

focused or glasses having poor definition, or in long-continued observation even under the best conditions may cause headache or dizziness.

The observer should use the glasses as little as possible consistent with the work in hand and he should take every opportunity to rest his eyes. Officers in charge of observing parties on work requiring continuous observation should see that the observers are frequently relieved and should give every consideration to men who complain of eyestrain or headaches from the use of field glasses.

At present machine gun companies are equipped with a 10-power glass. Some men find it impossible to hold a glass of this power steady enough with the hands alone for proper observation. This is largely a matter of practice, but for those who have difficulty in the use of these high-power glasses a rest is recommended. This may consist of a simple rod with means of attaching it to the glass and permitting of a movement of the glass in azimuth and elevation. The rod may be forced into the ground or merely rest on the surface. The rod should be adjustable in length to permit of use while standing or kneeling; its use in the prone position is unnecessary.

71. Care and preservation.—The ordinary military field glass is a rugged, serviceable instrument. Occasionally screws work loose; therefore all screws should be periodically tightened. In hot, moist climates there is a tendency for the canada balsam cement between the lenses of the object glasses to deteriorate, and this causes spots on the object glass, but unless the damage is extensive the glass is still usable.

The majority of cases of damage to field glasses, especially those of the prism type, can be traced to the fact that they have been taken apart by their owners who have been unable to put them together again with the exact original adjustment.

It is seldom necessary to open a pair of field glasses for cleaning or otherwise, and when it is necessary the work should be done at the factory or by an expert.

If a glass has been damaged by a fall or blow and duplication of the image occurs, it may sometimes be corrected by taking one of the lens tubes in each hand and while looking through the glasses cautiously twisting or turning the hands until the duplication disappears. It is never possible entirely and permanently to correct duplication by this means, and the

glasses should be returned to the makers for overhaul at the first opportunity.

The exposed surfaces of the object and eyepiece lenses should be kept clean by an occasional light wiping with a soft, clean cloth very slightly moistened with water or alcohol. The lenses can be scratched by dust or grit on the cloth if they are rubbed vigorously. If alcohol is used care must be taken not to get it on the lacquer of the frame and the lens holders.

72. Exercises in the use of field glasses.

I.

Object: To teach the use of field glasses.

Method: (*a*) Each man adjusts the interpupillary distance of a pair of field glasses so that it is correct for his eyes. Each man then adjusts the focus for each eye.

(*b*) Each man then describes number of telephone or telegraph poles or other objects in a certain direction and gives any distinguishing marks thereon.

(*c*) Each man copies signs within range of the field glasses, such as signs and numbers on box cars, etc.

II.

Object: To teach how to locate an object with the field glasses and then pick it up with the naked eye.

Method: A target is placed in such position and against such background that it is difficult to see with the glass.

The observer is given the general direction and instructed to find the target. Using the field glasses he will note some prominent object or distinguishing feature of the landscape near the target which will also be visible with the naked eye. He will then note the position of this object with reference to the target in order that he may pick up the target without the aid of glasses.

THE MIL AS AN ANGULAR UNIT OF MEASURE.

73. An angular unit of measure is required in the direction and control of fire as an aid—

(*a*) In the estimation of the range.

(*b*) In determining the number of yards and men on an occupied front.

(*c*) In laying off the distance from the reference point to the target.

(*d*) In indicating the width and the subdivision of the target into parts for the purpose of distribution.

The system of angular measurement in terms of degrees, minutes, and seconds is very cumbersome. A much more satisfactory angular unit is the **mil.** This is the angle whose natural tangent is 0.001; an object 1 yard long at a distance of 1,000 yards subtends an angle of 1 mil. The value of the mil in the conventional angular measure is 3′ 26.2″.

74. Mils are conveniently measured with—

(*a*) A field glass fitted with a mil scale.
(*b*) The rear sight leaf of the rifle.
(*c*) The finger.
(*d*) The mil rule.

(*a*) The most accurate and convenient instrument for measuring mils is the field glass fitted with a mil scale, as is the type

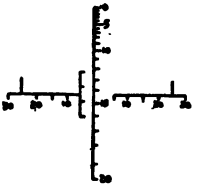


FIG. 10.

EE glass of the Signal Corps. The mil scale is engraved on a thin glass reticule which is accurately placed in the focal plane of the object glass. As a result the scale and distant field of view are in focus at the same time, and the scale can be superimposed on any object in the field of view by a slight movement of the glass. (Fig. 10.)

75. (*b*) **The rear sight leaf.**—It is essential that every man firing have a mil measuring instrument in order to interpret and carry out the orders of his superiors when these orders are given in mils in target and sector designation. A satisfactory unit is the "sight." The rear sight of the service rifle is 0.7 inch wide. If the eye of the firer is held 14 inches from the rear sight (fig. 11), i. e., over the comb of the stock, the sight will then subtend an angle of—

$$\frac{0.7 \times 1{,}000}{14} = 50 \text{ mils.}$$

All orders involving the use of mils in target designation given the men should be in terms of rear sights— the word **sight** being used.

76. (*c*) **The finger.**—The finger may be used in emergencies and should be held at such distance from the eye as to subtend 50 yards at 1,000 yards. As the fingers of all men are not the

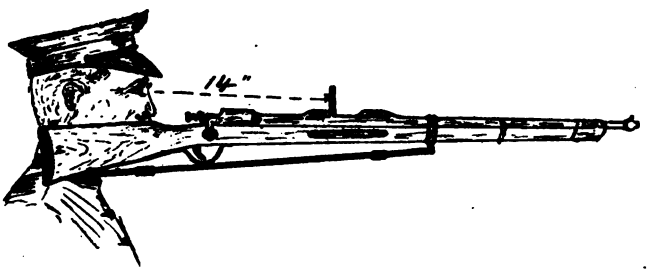


FIG. 11.

same width the distance that the finger is to be held from the eye must be determined in each case.

77. (*d*) **The mil rule.**—A 6-inch ruler with a cord 20 inches long forms a convenient mil measuring instrument. If constructed as shown in figure 12, it will serve for measurements of 300 mils or less.

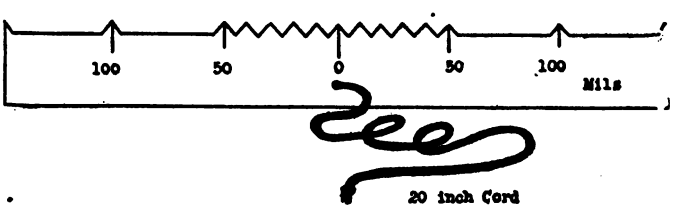


FIG. 12.

THE MUSKETRY RULE.

78. The Ordnance Department makes a combination mil rule and auxiliary rear-sight scale in the form of a musketry rule. (Figs. 13 and 14.)

With this instrument an angle may be measured in *mils* or in terms of the scale on the rifle sight.

The **musketry rule** consists of an aluminum bar 4¾ inches long, 1¼ inches wide and ⅜ inch thick. It is beveled on both edges and has a grooved slot, in the center of which

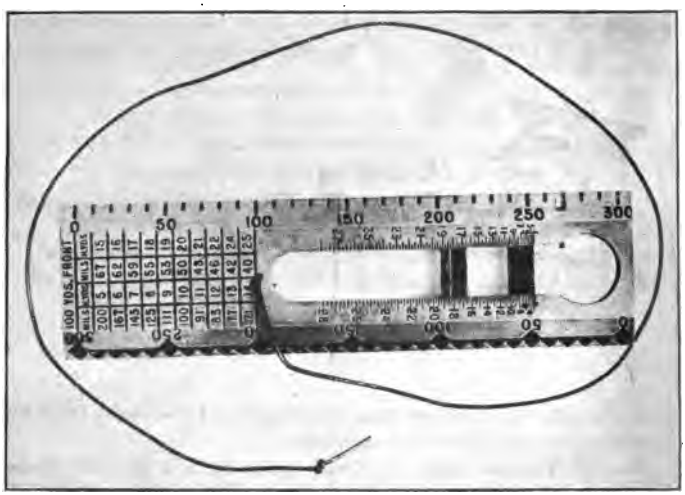


FIG. 13.

two brass sliders may be moved back and forth. A small spiral spring and friction pin is set in a hole in each slider so that the pin bears in the slot of the rule. This holds the slider

FIG. 14.

by friction at the point desired by the operator. A small steel stop pin set in the rule through the beveled edge and projecting into the slot for the sliders keeps the latter from being accidentally slipped out of the slots.

It will rarely, if ever, be necessary to remove the sliders from the rule; but if this should have to be done for any purpose, the stop pin should be pushed out to clear the slot, and the sliders may then be slipped into the enlarged part of the slot and removed. Care should be taken not to lose the spiral spring and pin which fit in the hole in the slider. In assembling the slider, the friction spring and pin must be in place, insert the slider in the enlarged end of the slot, hold back the friction pin with the point of a knife or similar instrument, and slip the slider into its grooves in the slot. Push back the stop pin when this operation is completed so that the slider can not slip out of the grooves.

79. In measuring angles, the rule is designed to be held 15 inches from the eye and perpendicular to the line of sight. In order to insure this there is a small hole in the center line of the rule, and through this passes a nonstretching cord with a knot in it 15 inches from the rule. The knot is held just under the observing eye with one hand while the rule is held with the other hand at right angles to the line of sight, the cord stretched lightly, and the scale in use superimposed on the area under observation.

The beveled edges of the rule are graduated from 0 to 300 mils in 10-mil divisions. The graduations consist of simple lines on one edge and of black sawteeth on the other, as each of these methods of graduation has its place in varying lights and backgrounds. The table on the face of the rule "100 yards front" and the three formulas are for use in connection with mil measurements.

The graduations along the center slot are reproductions on a reduced scale of the graduations on the rear sight of the service rifle and the two sliders have the same function as the leaf slide on the rifle sight.

80. The equations stamped on the back of the musketry rule are for the solution of simple problems involved in fire direction and control and are:

$$(1)\ R=\frac{W\times 1{,}000}{M}$$

$$(2)\ W=\frac{R\times M}{1{,}000}$$

$$(3)\ M=\frac{W\times 1{,}000}{R}$$

Where R equals range in yards, W equals width or height in yards, M equals number of mils subtended by W.

81. The following examples indicate the practical use of these formulas:

Examples.

I (*a*).

Object: Estimation of range.

Method: A certain tree is estimated to be 15 yards high. It covers an angle of 25 mils. It is therefore 600 yards away, for—

$$R=\frac{W \times 1{,}000}{M}=\frac{15 \text{ yards} \times 1{,}000}{25}=\frac{15{,}000}{25}=600 \text{ yards.}$$

I (*b*).

Object: Estimation of range.

Method: The telegraph poles on a distant railroad running at right angles to our line of sight are known (from previous measurement of such poles) to be 44 yards apart; the angle between two adjacent poles is observed to be 40 mils; the range to the railroad is, therefore, 1,100 yards, for—

$$R=\frac{W \times 1{,}000}{M}=\frac{44 \text{ yards} \times 1{,}000}{40}=\frac{44{,}000}{40}=1{,}100 \text{ yards.}$$

II (*a*).

Object: Estimation of fronts.

Method: A line of skirmishers at about one man per yard of front covers 40 mils on the scale; the range is known to be 800 yards; the number of men is therefore 32, for—

$$W=\frac{R \times M}{1{,}000}=\frac{8 \text{ yards} \times 40}{1{,}000}=\frac{32{,}000}{1{,}000}=32 \text{ yards (or men).}$$

(*b*) A column of infantry in "fours" is seen by a patrol at a range of 1,200 yards. It is moving across his front and covers 120 mils from head to rear of column. How many are in the column?

$$W=\frac{R \times M}{1{,}000}=\frac{1{,}200 \text{ yards} \times 120}{1{,}000}=\frac{144{,}000}{1{,}000}=144 \text{ yards.}$$

At two men per yard, the column contained 288 men.

III (*a*).

Object: Determination of the front to be covered in mils.

Method: A hostile force known to contain about 100 men is deployed in position 1,000 yards away, but so concealed that its flanks can not be seen or determined definitely. The company commander decides to cover a front of 200 yards with his fire, 100 yards on each side of a visible group of heads in the hostile line. How many mils should be covered?

$$M=\frac{W \times 1{,}000}{R}=\frac{200 \times 1{,}000}{1{,}000}=200 \text{ mils.}$$

(*b*) A machine-gun platoon known to contain two guns is concealed at a range of 900 yards with one of its guns visible through glasses. The company commander decides to cover a front of 50 yards on each side of the visible gun. How many mils should be covered?

$$M=\frac{W \times 1{,}000}{R}=\frac{100 \times 1{,}000}{900}=111 \text{ mils.}$$

THE MIL RULE AS A RANGE FINDER AND TELEMETER.

The mil rule may be used as a fairly accurate range finder and telemeter if it is possible to measure off a base, by pacing or otherwise, directly toward or away from the object, such as a trench, whose range and length is required. The factors in such a case are the length of the base and the angle in mils subtended by the object as measured from each end of the base. The formulas, derived from formulas (1) and (2) are:

When the base is measured *toward* the object in question:

$$(4) R=\frac{DM_2}{M_2-M_1}$$

When the base is measured from the object in question:

$$(5) R=\frac{DM_2}{M_1-M_2}$$

In which—

D=length of base in yards,

R=range in yards,

M_1=mils subtended by the object at the end of the base line from which the range is desired, and

M_2=mils subtended by the object at the opposite end of the base line.

Examples.

I (*a*).

Object: Use of mil rule as a range-finding instrument.

Method: From a point A, a hostile trench is visible in the distance. A mil measurement shows that the angle subtended by the trench is 150 mils (M_1). A scout now goes forward 360 paces (300 yards), thus getting a base line D, and measures the angle subtended by the trench from his advanced position. He finds that the trench covers an angle of 200 mils (M_2), and signals back to point A this information and the distance D that he went forward. The range from A to the hostile trench and the length of the trench may now be calculated, using formulas (4) and (2):

$$R=\frac{300 \times 200}{200-150}=\frac{60,000}{50}=1,200 \text{ yards, range to trench.}$$

The range having been found, the width is determined by the use of formula (2):

$$W=\frac{RM}{1,000}=\frac{1,200 \times 150}{1,000}=180$$

(*b*) We have come to a river bank and a village across the river covers angle of 150 mils (M_1). An observer walks back 200 yards (D), keeping our party on the river bank in line with the village, and finds at that point that the village covers an angle of but 120 mils (M_2). Using in the case formulas (5) and (2), the range from the river bank to the village and the size of the village may now be calculated.

$$R=\frac{200 \times 120}{150-120}=\frac{24,000}{30}=800 \text{ yards range to village.}$$

The range having been found, the width is determined by the use

$$W=\frac{RM}{1,000}=\frac{800 \times 150}{1,000}=120 \text{ yards=width of village.}$$

The use of the mil rule for such range-finding work is of great value just prior to an attack. The range to the enemy and the length of a certain part of his trenches or the distance between two prominent objects along his line can be determined with accuracy beyond effective rifle range. Thereafter, as the attacking line approaches the enemy, the range can be esti-

mated by deducting the distance advanced from the original measurement. The range can then be obtained with accuracy at any time simply by taking one observation with the mil rule and using formula (1) as given on the back of the rule.

In using this method at ranges between 800 and 1,500 yards the base D should be from 100 to 300 yards long (longer as the range is greater), and the mil measurements should be made on objects that subtend angles of 50 to 300 mils. The method will work with longer or shorter bases and larger or smaller angles, but the figures given will insure sufficiently accurate results.

EXERCISES IN THE USE OF THE MIL SCALE, REAR SIGHT, AND FINGER.

82. I.—**Object:** Laying out a mil scale in feet on a building or board fence on which to adjust the mil rule rear sight, and finger.

Method: Pick out a building or board fence where a clear horizontal length of over 30 feet is available. Lay out on this surface a scale of feet, 30 feet long, marking the zero, 5, 10, 15, 20, 25, and 30 foot marks prominently, and respectively 50, 100, 150, 200, 250, and 300. The marks should be heavy enough to be seen clearly from a distance of 100 feet. Lay off from the center of this scale a distance of exactly 100 feet perpendicular to the scale and set a stake there. Then with the observer at the stake 5 feet on the scale equals 50 mils, or one rear sight, or one finger.

83. II.—**Object:** To test the length of the cord on the Musketry Rule.

Method: The observer now stands so that the observing eye is exactly over this stake (par. 82), and holding the instrument as described, observes the 30-foot scale. The length of the cord should be such that the whole mil scale coincides with the 30-foot scale at 100 feet distance. If not, the length of the cord must be changed until it does. The mil scale should also be tested on the interior marks of the 30-foot scale, not so much on account of possible inaccuracies in the graduations of the mil scale as to afford practice to the observer in the use of the instrument. It should be tested in the standing, sitting, and prone positions, particularly the last.

84. III.—Object: To teach the use of the rear sight.

Method: The method of holding the rifle and using the rear sight (fig. 11) as an instrument for making angular measurements is explained to the soldier. Each man then steps to the stake (par. 82) and holds his rifle in such a position that the intercept of the rear sight leaf subtends 50 mils on the scale. The man is then told to measure the length of the scale in rear sights. Practice is repeated as with the mil scale; such exercises being given as "two and one-half sights from that (naming some prominent object) as a small bush." In this manner the men soon learn to use 1/5, 1/4, 1/3, and 1/2 of a rear sight.

85. IV.—Object: To teach the use of the finger.

Method: The advantage of at times being able to use the finger in the same manner as the rear sight is at first explained. Each man is then directed to hold his forefinger at such distance from his eye that it subtends an angle of 50 mils on the scale.

This is repeated until proficiency is acquired in holding the finger at the proper distance, the men using the forefinger, middle finger, and index finger only. The little finger being smaller is not used.

The soldier first makes measurements with the fingers, then verifies this measurement with the sight. After some practice the accuracy of the finger method, while not equal to the mil scale or sight, is remarkable.

Precision and rapidity of observation can not be attained without constant practice and, if the user desires really to become proficient in the use of the mil scale, he should lay out, in addition to the horizontal scale, other vertical and inclined scales of feet and practice on them from the stake 100 feet distant.

86. Switching fire.—The mil system as described may be used in switching targets. If, for instance, it is desired to change laterally to a new target, the prescribed signal for switching fire is made, "two fingers to the right," for example, and each and every man then changes his fire the designated distance to the right as has been signaled. The front covered by the fire of the unit remains the same width but the center of the sheaf has been moved 100 mils to the right.

87. Use of musketry rule in connection with combined sights.—One other feature of the musketry rule remains to be mentioned. This is the simple device to obtain the sight settings

when it is desired to use combined sights. Set both sliders at the range, estimated or measured, to the target. If two elevations are to be used, use the sight setting indicated by the mark numbered 2 on each slider. If three elevations are to be used, use the settings indicated by the mark numbered 3 on each slider and the sight setting corresponding to the true or estimated range, making three in all. This device is approximately accurate only for ranges less than 1,300 yards.

CHAPTER V.

THE DESIGNATION AND RECOGNITION OF SERVICE TARGETS.

88. The adoption of smokeless powder, neutral-tinted uniforms, and the prominence given to the concealment of trenches, use of cover, and suitable backgrounds all tend to diminish the visibility of the enemy and thus increase the necessity for training in the designation and recognition of targets. Poor description of targets or a delay in opening fire results in a loss of fire effect that may prove disastrous in the critical stages of an action.

For example, a faulty description is confusing, all of the men will not recognize the target, and there is a consequent delay in the opening of fire. This is especially true with fleeting targets. Bad description may result in a part or the whole of the unit mistaking the target, the outcome being a total loss of fire effect on account of firing at the wrong target. Part of the line may become confused and not fire at all.

89. Facility in target designation and recognition requires that the soldier be given a thorough course in—

(1) A system of describing targets.

(2) The determination of the range.

(3) Visual training.

The system in describing targets is taken up first, in order that the soldier may be able to describe what he sees and practice the system while engaged in estimation of distances and in the visual training course.

The estimation of distances follows, and is taken up in connection with visual training.

The range is given first in the fire order for two reasons:

(1) The men set their sights, and thereafter devote all their attention to locating the enemy.

(2) The range is part of the designation, in that it helps the soldier to locate the target.

90. The systems used in describing targets are given under the heading—

TARGET DESIGNATION.

Within the regiment implies an ability on the part of the regimental commander to describe an objective and its subdivisions from the map as well as from the ground, and such training on the part of his subordinates as will insure the correct translation of his map designation into parts of actual terrain.

A regimental commander under ordinary conditions of service deals with fronts or sectors of such dimensions that, even in describing the target on the ground, physical features will be found marking the limits of the battalion objectives, and a resort to any elaborate system of description would not be necessary. However, regimental commanders as well as battalion commanders should be able to describe a target with the same facility as can the platoon leader.

"Within the battalion" implies not only an ability on the part of the battalion commander to describe an objective without ambiguity, but also a uniformity of training throughout the battalion which will enable the men of one company to describe intelligently to men of other companies of the battalion both targets and fronts or sectors in language and by methods with which both are familiar.

"Within the company" implies an ability on the part of the company commander to describe the objectives or fronts for his platoons within the limits assigned to the company. It also implies an ability to cover the whole target of the company during a forward movement of part of the company.

"Within the platoon" implies an ability on the part of the platoon leaders to understand the company commander's designation of the target and to transmit that information to their platoons in such a manner as to insure an equal distribution of their fire within the front assigned them as objectives, not slighting the less visible parts.

All of the foregoing makes necessary a system of describing and defining targets that will enable commanders to describe in the shortest possible terms the most difficult targets to their men. This system must be simple and easy to learn. A good system of indicating targets is by reference points consisting of natural or other features of the ground located in the frontage assigned to a unit. If targets can not be indicated with

sufficient accuracy by reference points alone, supplementary methods are used in description in connection with those points.

91. In general, targets, with reference to their designation, will fall under the following heads:

(1) Those that stand out so plainly that there can be no possibility of doubt as to what and which target is meant.

(2) Those that are plainly visible but about which there might be some misunderstanding.

(3) Those which are partially visible but which, on account of backgrounds or other conditions, are difficult to pick up.

(4) Those which can be seen only with field glasses.

92. Methods of designation.

CASE I.

System.	*Example.*
1. Announce range.	"Range 1,000."
2. Announce objective.	"A troop of cavalry."

CASE II.

The horizontal clock system may be used (with visible targets). To avoid confusion it is necessary when using a clock system to preface the direction with the words "reference point" or "target."

System.	*Example.*
1. Announce range. (If sights are to be set, allow time necessary.)	"Range 1,000" (men set sights).
2. Announce direction.	"Target at 2 o'clock."
3. Announce objective.	"A troop of cavalry dismounted."

PROCEDURE.

1. All set sights at 1,000 yards.

2. In using the horizontal clock system, the firer considers himself to be at the center of the clock dial, 12 o'clock being his true front, i. e., on a line perpendicular to the firing line. Six o'clock, then, would be to his rear, 9 o'clock to his left, and 3 o'clock to his right. The individual would be facing toward 2 o'clock in this instance if he made a little more than a half right face; to be precise, a two-thirds right face.

When the direction is announced, all look in the designated direction; in this case, toward 2 o'clock.

3. Look for objective at 1,000 yards on this 2 o'clock line.

CASE III.

The vertical clock system is used either singly or in combination with the horizontal (against small or indistinct targets).

SYSTEM.	EXAMPLE.
1. Announce range. (If sights are to be set, allow time necessary).	"Range 1,000" (men set sights).
2. Announce the general direction of the reference point.	"Reference point to our right front" (or "at 2 o'clock").
3. Designate as a reference point the most prominent object in the zone indicated.	"A stone house with two chimneys."
4. Announce the position of the target with respect to the reference point.	"Target at 3 o'clock."
5. Announce objective.	"A hostile patrol of four men."

PROCEDURE.

1. Men set sights at 1,000 yards.

2. All men look to their right front (or along the 2 o'clock line).

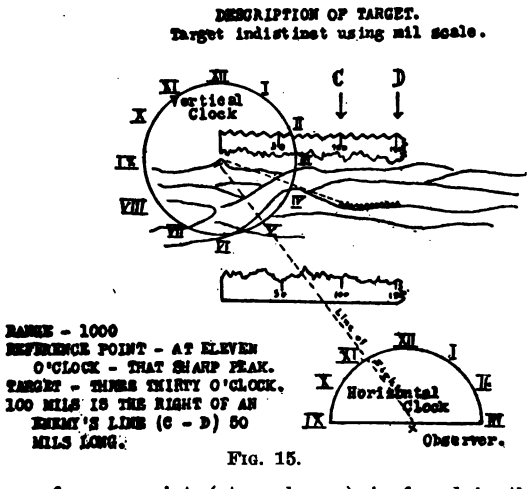
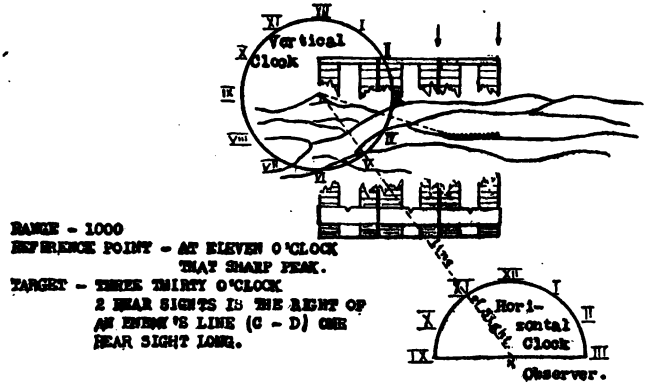

DESCRIPTION OF TARGET.
Target indistinct using mil scale.
Vertical Clock
C
D
RANGE - 1000
REFERENCE POINT - AT ELEVEN O'CLOCK - THAT SHARP PEAK.
TARGET - THREE THIRTY O'CLOCK.
100 MILS IS THE RIGHT OF AN ENEMY'S LINE (C - D) 50 MILS LONG.
Horizontal Clock
Observer.

FIG. 15.

3. The reference point (stone house) is found in the indicated direction.

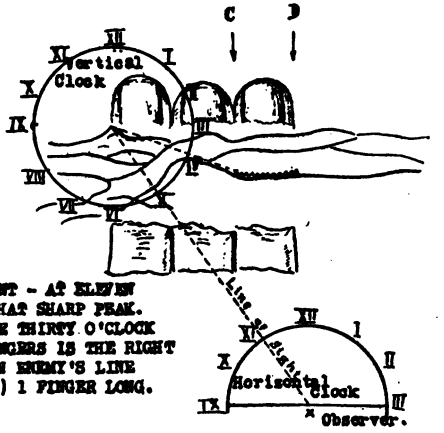
DESCRIPTION OF TARGET.
Target indistinct using rear sight.



RANGE - 1000
REFERENCE POINT - AT ELEVEN O'CLOCK THAT SHARP PEAK.
TARGET - THREE THIRTY O'CLOCK 2 REAR SIGHTS IS THE RIGHT OF AN ENEMY'S LINE (C - D) ONE REAR SIGHT LONG.

FIG. 16.

DESCRIPTION OF TARGET.
Target indistinct using fingers.



RANGE - 1000
REFERENCE POINT - AT ELEVEN O'CLOCK - THAT SHARP PEAK.
TARGET - THREE THIRTY O'CLOCK 2 FINGERS IS THE RIGHT OF AN ENEMY'S LINE (C-D) 1 FINGER LONG.

FIG. 17.

4. A clock face (vertical) is imagined centered on the reference point, and the men look along the line leading from the clock center through 3 o'clock and—

5. Find hostile patrol at 1,000 yards from the firing point.

Figures 15, 16, and 17 show the application of the system using the horizontal and vertical clock systems in combination.

The rear sight should be used when describing targets to the men; however, all men should understand the use of mils and fingers.

CASE IV.

Requires the use of an auxiliary aiming target. (See Chapter IX).

Its description is the same as any other target.

93. Company commanders, platoon leaders, and leaders of independent organizations, at the conclusion of a movement or when occupying a position, should select reference points and describe them to the men. The number of points necessary will depend on the nature of the ground and whether it has little or much detail in the shape of prominent natural or other features, but points should be selected so as to facilitate the indication of targets in all parts of the field of fire. In selecting these reference points, the most prominent should be chosen. They should be in the distance or middle of the field of fire, and as far off as possible. No two points, if it can be avoided, should be similar; as, for instance, two church spires and two clumps of trees. The points should be as far apart as possible. Each point should be indicated and the men told the name by which it is known. Targets are indicated by short, accurate, clearly understood descriptions as to their nature, features, and exact position.

94. Field glasses may be used to pick up targets that are difficult to locate, but the aiming targets are always described as they are seen with the naked eye and not as seen through the field glasses. Otherwise men who are without glasses will not recognize the target. In both attack or advance the front or 12 o'clock point is indicated in order that when a direction is used to indicate a target the men will look in the proper direction with regard to the front.

95. The mil, rear sight, finger, and clock-face methods of describing targets are only to be used when they simplify, shorten, and make more accurate the method of designation

and description. Only one system of indicating targets should ever be employed in a battalion, and, if possible, in an army, so that the men may recognize targets described by commanders other than their own. Men separated from their own organization will then not be confused by strange systems.

If possible, targets are described and their range given before occasion for firing arises, in order that the men may adjust their sights and be ready to open fire without further orders as soon as the target appears.

Reference points are not used when the target is plain and of such a nature as to be easily pointed out.

FIG. 18.

Orders should always be as short as possible without losing clearness. Hence, to use a reference point when not called for is to add more to the order than necessary.

Reference points should be definite and easily distinguished.

Of what value is it to announce a reference point that is as hard to see as the target?

Data given from reference point must be complete.

The distance from the reference point to the right, left, or center of the enemy's line should always be stated, as well as the width of the target that it is intended to cover. **Do not sacrifice clearness to brevity.**

The company is always deployed facing the target.

96. The system of describing targets as given herein is that followed by most military authorities on this subject. Some writers shorten the form somewhat by the so-called unit system, giving the number of rear sights or fingers as 2, 3, etc., but leaving out the unit, this being understood by the men. The School of Musketry board at Fort Sill is unanimously of the opinion that it is preferable to add the unit of measure and say "2 fingers," "sights," etc.

The "face as I face" method, advocated by some, is not good. A slight difference in the front is likely to cause confusion.

FIG. 19.

97. Suggested exercises.—The recruits should be taught the designation of targets in slow and easy steps. It is assumed that while studying the subject of instruments he has learned to use the mil, rear sight, and fingers in the measurement of angles.

I.—**Object:** To teach the use of horizontal and vertical clock faces.

Method: Many men, due to lack of imagination, will find it hard to understand the application of the clock face to the designation of targets.

Figures 18 and 19 show a graphical method of teaching that has been successfully tried.

The 2-clock faces are made on regular 6 by 6 target frames. The strings indicate the line of sight of the soldier. The center of the vertical clock is at the top of the post. The whole apparatus can be made in a very short time and is very useful in stimulating the men's imagination.

II.—**Object:** To teach the selection of a reference point.

Method: The squad is taken to some point from which several good reference points might be selected, and the good and bad features of several are pointed out. Men are cautioned that two points of a similar nature in the same field of view are not to be selected. For instance, one of several telegraph poles, one of several trees, etc. Each man is directed to take aim at the reference point and the aim is checked.

III.—**Object:** To use a reference point in connection with the clock system.

Method: A reference point is selected and described, using the horizontal clock. A target is named as "Target, 3 o'clock, two sights, a small bush." Each man aims his rifle at the bush, using a sandbag rest. The aim is verified by the instructor. This is repeated until all are proficient.

IV.—**Object:** To teach when not to use reference points.

Method: At this stage of the instruction it will be found that the men have become wedded to reference points and that they will use them in describing objects and targets when such description is unnecessary.

The squad under instruction is taken to some point screened from the target. The target is represented by a squad of men concealed a short distance in front of the men under instruction. At a signal from the instructor the squad acting as the target stands up in plain view. The men under instruction then write their description of the target.

All solutions are then read and errors pointed out.

If advisable, a landscape target may be used to advantage in the designation and recognition of targets.

CHAPTER VI.

VISUAL TRAINING.

98. One of the essentials in teaching the designation and recognition of service targets is the cultivation of the recruit's vision, that is to teach him *what* to look for and *how* to look for it.

(Par. 157, I. D. R., in part:) "The ability to use his eye is of great importance to the soldier. The recruit should be trained in observing his surroundings from positions and when on the march."

Scouts or patrols preceding the command going into action or those providing for security on the march or in action must be able to recognize and distinguish hostile and friendly troops.

Exercises framed to stimulate the soldier's power of vision should be commenced at the earliest period of his training and continued throughout his service, in order that he may appreciate, by daily association, the necessity for cultivating a quality of such importance in modern warfare.

Visual training includes general reconnaissance, the recognition of targets described, impressions as to size, and observation of the result of fire.

The training usually commences with questions framed to develop the recruit's memory, his power of observation and his ability to describe what he has seen.

99. Suggested exercises.

I.—**Object:** To teach observation and memory.

Method: The recruit is taken to a window in the barracks and directed to look out the window for five seconds, then face about and describe what objects he has seen. His attention is then called to the numerous objects he missed.

The recruit is directed to count the panes in the windows of a building.

The squad is taken for a short march and upon return to the barracks or camp the men are called upon to tell what they saw on the march.

II.—**Object:** To teach an effective method of searching a given area.

Method: To search a given area thoroughly the man's sight must not be permitted to wander aimlessly, but must be directed in such manner that every portion of the area is subjected to rigid scrutiny. To meet this demand, a system is necessary that will assure that no portion of the area is overlooked or slighted.

There are two systems or methods in general use. Both systems subdivide the area by a number of imaginary lines, in one case these lines being at right angles to the line of sight and in the other case being parallel to it. The division by lines parallel to the line of sight usually will be productive of the better results.

It is explained to the recruit that it is of no special importance *what* system is used, but that it *is* important that *some* system be used that will give the required results.

Having completed the explanation of the exercise, the instructor indicates certain boundaries in which various objectives of a military nature have been placed beforehand and directs the men to search this area and describe all such objectives as they are able to locate.

As progress is made, the area, the amount of cover used, the size and number of the objectives, and the ranges are gradually increased.

As a check on the man's imagination, the instructor occasionally designates an area in which no objectives have been placed.

Up to this point only natural cover has been considered. It is also important for the soldier to become familiar with natural or cultural features, and then to note the changes that occur when the same objects have been adapted to military uses.

Usually a saving in time may be affected by having this practice in conjunction with that in field engineering.

III.—Object: To teach the effect of distance on the appearance of objects, and the recognition of service targets.

(I. D. R., 158, in part:) "They (the men) should be taught to distinguish from a prone position distant objects, particularly troops, both with the naked eye and field glasses."

Method: Targets and men are placed beforehand in different positions at various ranges and on different radial lines from the point at which the exercise is to be carried out. Some of the targets are wholly exposed and some partly behind cover.

The men undergoing instruction are informed where to look for the targets and are given the distance to each. The principle illustrated is carefully explained, and it is pointed out

that a knowledge of the appearance of targets at different ranges is at times an invaluable aid in the estimation of distances, to be taken up later.

IV.—**Object:** To teach the effect of backgrounds and distinct and neutral tinted uniforms on the visibility of targets.

(I. D. R. 407, in part:) "By skillful use of ground a firing line may reduce its visibility without loss of fire power."

Method: It is a safe rule that a term used for the first time should be explained to the men. Hence the instructor explains what is meant by background and visibility.

Unknown to the squad under instruction, a number of targets and men representing the target are placed in various selected positions, some in the open, some partly behind cover, and some against different backgrounds.

The targets should include both known distance targets, A, B, and C, and the service targets. The men representing targets should be dressed in uniforms of distinct and neutral tints, with the object of showing the difference in visibility of distinct and neutral colors against the same background. The difference between the visibility of an olive-drab uniform against a white wall, a sheet of water, a sky line, dark ploughed land, and a green field should be illustrated.

During the exercises instructors take advantage of the opportunity to utilize the useful object lessons they provide for instruction in the use of ground and cover.

It is pointed out that the more visible the target the easier it is seen, and consequently it is easier to aim at and hit. Therefore the effect of fire against this target will be greater than will be fire against one less visible, other conditions being equal. A target clearly visible facilitates the estimation of distance, while on the other hand the vulnerability of targets—that is, the likelihood of their being hit—is decreased in proportion as they are indistinct or hard to see.

The men are told to note that concealment may be possible even in the open without cover and that cover from view is often best obtained by a suitable background. In the selection of a background one must consider the possibility of hostile observation from the flanks as well as from the front.

There is nothing more demoralizing, nothing in war that tends to lower the morale of a fighting force so much as to find itself lying down within effective or even decisive range of an enemy and, while losing men, yet be unable to locate the enemy. British soldiers often had this experience in the Boer war. The Boers

were past masters in the selection of backgrounds, and when they sat down in a position they were sure that they had behind them rocks or dry grass of the same color as their clothes. In many engagements the British fired hundreds of rounds at the hills without killing a Boer, simply because the Boers could not be seen.

V.—**Object:** To teach the effect of movement on the visibility of targets and the need for avoiding unnecessary movements in loading and firing.

Method: It is explained that the enemy will use every endeavor to obtain concealment and when seen at all will usually be in the prone position. Perhaps only the head and shoulders are seen above the parapet of a trench, or part of the head and shoulders will appear from behind a tree or wall.

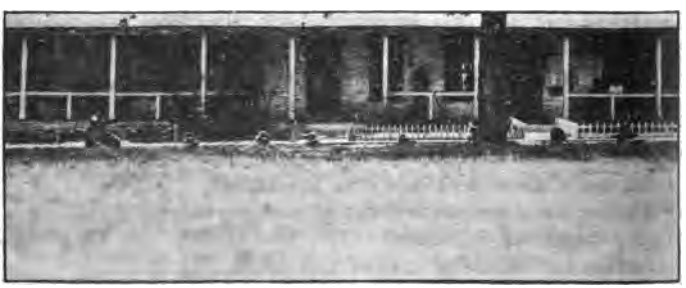


FIG. 20.

The instructor then conducts the men to the point selected for the exercise. This point should admit of a wide arc of vision and should permit of an uninterrupted view for a distance of from 100 to 200 yards.

Several assistants are posted beforehand at various short ranges and in various directions from the central point. They make use of no cover, but are in the prone position and are required to remain quiet or at least to make no conspicuous movements.

The instructor informs the men that one of his assistants is lying prone at a distance of less than ———— yards; that he is in the open and in the general direction of ———— [indicating by pointing the general direction of the first objective]. He then directs them to look the ground over carefully and attempt to locate this man. and then calls them up in turn and

causes them to point out his position. For this purpose a rifle with sandbag and tripod may be used to advantage, the recruit being required to sight the rifle at what he believes to be the objective.

Should any of the men fail to locate the objective the instructor signals to the assistant to raise his arm or move from side to side. A very slight movement usually will betray his position.

This is repeated until all the objectives have been located.

100. It is pointed out to the squad that—

(*a*) A figure which is invisible to the naked eye while motionless catches the eye through movement, and

(*b*) While quick, short movements may escape the eye, and even if seen may make location difficult, movements prolonged,

FIG. 21.

even for a short time, catch the eye and facilitate aiming. This object lesson emphasizes the rule that movements in the open should be confined to those which are absolutely necessary, and that these should be made smartly. Recruits are trained to assume various firing positions rapidly and to perform the loading and aiming motions with as little movement as possible. All unnecessary movements in performing these motions are avoided.

Note the unnecessary movement of the man on the left in loading.

In figure 21 the men are preparing for a rush. Note that only one man (the man on the right) is keeping his head down. Compare the size target he offers to an enemy with that of the other men in the squad, especially the second man from the left.

CHAPTER VII.

THE DETERMINATION OF RANGES.

101. Any error in the determination of the range to the target plays a most important part in the efficacy of the fire.

When it is remembered that the placing of the center of impact is not a question of aiming but the result of an ordered angle of sight (range), and that in war ranges are estimated—and usually very poorly—it will be seen that unless the range be accurately determined, more hits will result from average shooting than from very fine shooting. That marksmanship has nothing to do with location of the center of impact is easily demonstrated by reference to a table of ordinates. To examine an extreme case, suppose that the range is actually 600 yards, but is estimated at 1,200 yards, the firing being over a level plain.

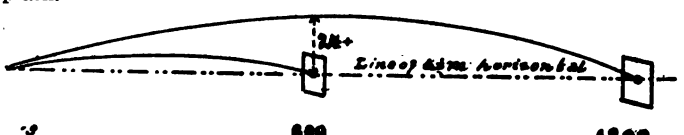


FIG. 22.

The line of aim is horizontal and is not changed by an incorrect estimate of the range. With a correct elevation, the trajectory rises to its summit and then falls, meeting the line of aim at the target where the point of aim and center of impact should coincide. With sights set at 1,200 yards, the trajectory is still rising at a range of 600 yards and is 24 feet above the line of aim and point of aim. (Fig. 22.)

If the target is 6 feet high and the point of aim is at the center of the target, the mean trajectory will be 21 feet above the top edge of the target. With an assumed cone or sheaf 24 feet in diameter at 600 yards, so that the lowest bullets are 12 feet below the center of the sheaf (mean trajectory), it is evident that these lowest bullets are 9 feet above the top of the target, making no hits at all. And this displacement of the center of

impact is the case without any regard at all to the skill of the firers, the only result of skill in shooting manifesting itself in the size of the cone. With poorer shots (assumed dispersion such as to produce a cone 30 feet in diameter) a few scattering hits would be expected. The point of aim in each case being the same would not influence the result; but the shooting skill of the marksmen does affect the result in a manner entirely unexpected to one ignorant of the principles involved.

102. It is to be observed that two factors enter into the probability of hitting:

(1) The skill of the men in individual shooting; (2) the accurate determination of the range.

If an officer can not obtain and announce the elevation with reasonable accuracy to his men it is self-evident that his organization will attain results in war in inverse ratio to the skill of the men in shooting.

Experiments conducted in the fifth brigade at Galveston with four regiments of Infantry, involving hundreds of estimates by trained estimators, confirmed previous experiments here and abroad that the "probable error" in estimating the range to battle targets over unknown ground and at Infantry ranges is 12.5 per cent. By using the "probable error" as a basis of discussion one recognizes that in one-half of all cases the error will be greater than the probable, and that in the other half the error will be less than the "probable error."

If a series of target screens be placed one behind the other on a horizontal plane and at 25 yards apart, each screen 8 feet high, and the line of sight at the center of the targets, average marksmen, good marksmen, and poor marksmen with sights set at 1,000 yards should make the number of hits shown on each of the targets, as follows:

Yards, targets.	875	900	925	950	975	1,000	1,025	1,050	1,075	1,100	1,125
Good.....	0.0	1.5	8.2	19.0	33.5	40.0	31.0	15.4	4.8	0.8	0.0
Average.....	3.1	7.5	12.9	19.6	24.6	26.4	23.2	16.8	10.0	4.7	2.3
Poor.....	8.9	10.3	11.7	12.5	13.3	13.4	12.6	11.0	9.6	7.3	6.4

From this table it is seen that the target at the correct range—1,000 yards—received the most hits when fired at by the good marksmen and the least when fired at by the poor marksmen. Good marksmenship, therefore, brings its reward

in the number of hits made on a target; that is, at the range for which the sights are set. Examining the end targets, which are in error 12.5 per cent, these results are reversed, and the poor marksmen made more hits than either of the other classes.

103. An examination of the foregoing table shows that the results expected from average marksmen exceed those expected from good marksmen if an error of 50 yards has been made in estimating the range to a 1,000-yard target, but that if the range is correctly determined the good marksmen will attain 50 per cent more hits than the average marksmen. *The purpose of training is to secure a maximum of hits; therefore individual marksmanship and range determination are equally essential.*

In the foregoing discussion it is assumed that a group of men are firing with a common sight setting. On the other hand, if each man estimates the range for himself and fires individually with his own choice of elevation, assuming that the men can estimate as well as the company range estimators, the error to be expected of each man is 12.5 per cent, as before, but since some are shooting with an elevation 12.5 per cent too high and others with the same error but too low there results a combined shot group made up of many smaller groups each of the same size, but arranged each about its own center of impact. The combined group being larger than any one of the individual groups. Such a procedure has the effect of lowering the classification of the marksmen so that good shots are reduced to average, while average marksmen fall into the poor class.

Average marksmen, when using a common sight setting, at 800 yards expect 34.4 per cent of hits against a certain target. With individnal estimates of the range, they can expect but 15 per cent. This loss of effect varies with the range and the quality of the marksmen.

104. To summarize.—It has been proven:

(1) That there is a great advantage in small dispersions (individual expertness in shooting) when the range is exactly known.

(2) That the advantage of small dispersions (individual expertness in shooting) decreases with the range *when a correct elevation is not used.*

(3) That the smaller the dispersion (individual expertness in shooting) the more rapidly the effect decreases with an incorrect elevation.

(4) That up to 500 yards precision is of more importance than the estimate of the range.

Therefore, thorough training in the determination of ranges is a necessary part of the training in marksmanship.

105. The following table shows the theoretical effect of errors in the determination of the range:

Errors in yards.

Range used.	0	50	100	150	200	250	300	350	400
400	100	96	83	67	49	32	21	12	8
450	100	95	81	62	43	27	16	9	6
500	100	93	78	57	36	21	10	6	3
550	100	92	74	50	30	15	7	4	1
600	100	91	69	43	23	9	4	2	0
650	100	90	64	38	18	7	3	0	.....
700	100	88	59	32	13	5	1	0	.....
750	100	86	55	27	10	3	0	.....	.....
800	100	84	50	22	6	1	0	.....	.....
850	100	82	46	18	5	1	0	.....	.....
900	100	80	41	13	3	0	.....	.....	.....
950	100	78	37	11	2	0	.....	.....	.....
1,000	100	75	32	8	1	0	.....	.....	.....
1,050	100	73	30	7	1	0	.....	.....	.....
1,100	100	70	27	5	0	.....	.....	.....	.....
1,150	100	69	24	5	0	.....	.....	.....	.....
1,200	100	67	20	4	0	.....	.....	.....	.....
1,250	100	65	18	3	0	.....	.....	.....	.....
1,300	100	63	15	2	0	.....	.....	.....	.....
1,350	100	59	13	1	.....	.....	.....	.....	.....
1,400	100	55	10	1	.....	.....	.....	.....	.....
1,450	100	54	9	1	.....	.....	.....	.....	.....

The figures in the body of the table show, in theory, the probable number of hits that would be obtained for any given estimate of the range and for any given error in that estimate. This is on the assumption that 100 hits will be obtained when there is no error in the determination of the range.

For example, assume a true range of 950 yards to have been determined as 1,000. The error is 50 yards. What is the effect of this error?

In the column headed "Range used," find the amount corresponding to the estimated range (1,000). Follow this line to the right until entering the column corresponding to the error (50). Here is found the number 75. This number 75 indicates that for every 100 hits that would have been obtained with the correct range, but 75 hits would have been obtained with this particular error.

106. Before fire for effect is opened ranges may be determined by one of the following methods:

(*a*) Estimating distances by the eye.

(*b*) Taking the range from a map of large scale.

(*c*) Obtaining it direct from infantry or artillery already engaged.

(*d*) Measuring the range directly on the ground.

(*e*) Estimating distance by sound. (Par. 82, S. A. F. M.)

(*f*) Range finders.

(*g*) Mil rule. (Par. 78.)

(*h*) Ranging fire.

ESTIMATING DISTANCES.

107. *Estimation of distance by the eye.*—To estimate distance by the eye with accuracy it is necessary to be familiar with the appearance, as to length, of a unit of measure which can be compared mentally with the distance which is to be estimated. The most convenient unit of length is 100 yards. To impress upon the soldier the extent of a stretch of 100 yards two posts 100 yards apart, with short stakes between to mark each 25 yards, should be placed near the barracks or on the drill ground and the soldier required to pace off the marked distance several times, counting his steps. He will thus learn how many of his steps make 100 yards and will become familiar with the appearance of the whole distance and of its fractional parts.

Next a distance of more than 100 yards will be shown him and he will be required to compare this distance with the 100-yard unit and to estimate it. Having made this estimate, he will be required to verify its accuracy by pacing the distance.

A few minutes each day should be spent in the practice, the soldier often being required to make his estimate by raising his rear-sight leaf and showing it to the instructor. After the first drills the soldier should be required to pace the distance only when the estimate is unusually inaccurate.

The soldier should be taught that, in judging the distance from the enemy, his estimate may be corrected by a careful observation of the clearness with which details of dress, the movement of limbs, or of the files in a line may be seen. In order to derive the benefit of this method the soldier will be required to observe closely all the details noted above in single men or squads of men posted at varying distances, which will be measured and announced.

Although the standing and kneeling silhouettes used in field practice afford good objects upon which to estimate distances, the instructor should make frequent use of living figures and natural objects, as this is the class of targets from which the soldier will be compelled to estimate his range in active service.

108. *Methods of estimating long distances by the eye.*—The following methods are found useful:

(*a*) The soldier may decide that the object can not be more than a certain distance away nor less than a certain distance; his estimates must be kept within the closest possible limits and the mean of the two taken as the range.

(*b*) The soldier selects a point which he considers the middle point of the whole distance, estimates this half distance, and doubles it, or he similarly divides the distance into a certain number of lengths which are familiar to him.

(*c*) The soldier estimates the distance along a parallel line, as a road on one side, having on it well-defined objects.

(*d*) The soldier takes the mean of several estimates made by different persons. This method is not applicable to instruction.

Appearance of objects; how modified by varying conditions of light; difference of level, etc.—During instruction the men should be taught the effect of varying conditions of light and terrain upon the apparent distance of an object.

Objects seem nearer—

(*a*) When the object is in a bright light.

(*b*) When the color of the object contrasts sharply with the color of the background.

(*c*) When looking over water, snow, or a uniform surface, like a wheat field.

(*d*) When looking from a height downward.

(*e*) In the clear atmosphere of high altitudes.

Objects seem more distant—

(*a*) When looking over a depression in the ground.

(*b*) When there is a poor light or a fog.

(*c*) When only a small part of the object can be seen.

(*d*) When looking from low ground upward toward higher ground. (S. A. F. M.)

109. The manner in which the subject of estimating distances is taught will depend in a large measure upon the local facilities as well as upon the experience and ingenuity of the instructor.

The following exercises are given as a guide to instructors, who may use them as they are or modify them at will to suit local conditions:

Organization commanders should utilize the rest periods while drilling, etc., in estimating distance drills and should appreciate that after the first preliminary drills very few, if any, special drills are required to teach the men to estimate distance.

As an illustration, the company is drilling around a central point, from which the company commander has previously determined the range to other prominent points in the vicinity. The company halts at the central point. The men are directed to estimate the range to one of the objects and set their sights for that range. Time, 10 seconds. Squad leaders check sight setting. Captain announces true range.

The course of training in estimating distances is divided into two distinct steps or stages:

First. Creating in the memory of the soldier an indelible picture of the appearance of the unit of measure from every possible viewpoint.

Second. Giving him practice in applying this unit of measure to all possible varieties of terrain and under all possible conditions of light and atmosphere.

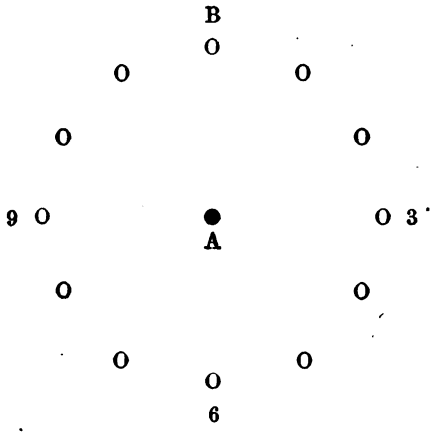
110. **First Stage.**—*First exercise.*—A distance of 100 yards (the unit of measure) is measured accurately on level, open ground and conspicuous marks are placed at each extremity of the line. It is explained to the soldier that this is the unit by which he is to estimate distances and that the attainment of proficiency depends upon his becoming familiar with the appearance of this unit.

He is then required to view this distance from each extremity of the line, and also from different points that are neither on the line nor in prolongation of it. He is then required to pace the distance several times that he may remember the average number of his paces per 100 yards.

Second exercise.—The unit of measure is marked as in the first exercise. Considering one extremity of this line (the extremity at which the soldier is to stand) as the center of an imaginary circle of 100 yards radius, stakes are placed on the circumference of said circle at every 30° or each hour of the clock. The stake "B" (see sketch) at the further extremity of the unit of measure is made quite conspicuous and is con-

sidered as geing at 12 o'clock. The other stakes are carefully concealed in such manner that their location is not apparent from the center stake at "A." They are referred to by the usual clock designation. The arrangement of the stakes will be modified to suit the conditions imposed by whatever ground happens to be available.

Sketch.



The instructor designates one or more men to assist him.

When the stakes are in place and the men (usually not more than a squad at a time) are assembled at the center the instructor directs one of his assistants to stand on the line from the center to the 1 o'clock or 11 o'clock stake and at a certain distance either short of or beyond said stake. He requires the men to turn their backs while the assistant is being posted.

The assistant being posted, the instructor causes the men to face toward the 12 o'clock stake. He then directs the men to compare the distance to the assistant with the true unit of measure and to decide whether the former is greater or less than 100 yards.

He then calls upon one of the men to direct the assistant to move forward or back and halt at a point that he, the estimator, considers is exactly 100 yards from the center stake. A memorandum is kept showing the assistant's actual distance

from the center stake, and the same procedure is repeated for each man in the squad, when the instructor causes the assistant to post himself accurately at 100 yards from the center stake, and then notifies the men of the amount and direction of their errors.

Under these conditions the errors should be small, as the soldier constantly has before him the measured 100-yard unit, which is in such close proximity to the line on which he is estimating that comparisons are quite simple.

As soon as the men show proficency in this first step the instructor causes the assistant to move to the 2 o'clock or 10 o'clock stake, then to the 3 or 9 o'clock stake, etc., gradually working away from the visible measured unit in order to make comparisons with it more difficult.

Third exercise.—This is the same as the second exercise, except that all marks showing the location of the farther end of the measured unit are obliterated.

The basis of comparison now must be the man's *recollection* of the appearance of the unit of measure.

When practicable this should not be held on exactly the same ground as the second exercise.

Fourth exercise.—From practice in the foregoing exercises the men will have become familiar with the appearance of the unit of measure when standing at one of its extremities. It next becomes necessary to familiarize them with its appearance when they are at a point in prolongation of the line and at various distances from its nearer extremity.

Level, open ground is used in this as in the foregoing exercises.

Stakes are arranged as prescribed in the second exercise, except that they will be placed on the circumferences of *two* concentric circles (or as extensive arcs as the nature of the terrain will permit), one having a radius of 100 yards and the other a radius of 200 yards. The stakes on the smaller circumference or arc will be made plainly visible, those on the larger being carefully concealed except one which marks the farther extremity of the unit of measure.

The procedure in this exercise is the same as in the second exercise, the men being required to place the assistant at a point which they consider 100 yards beyond the inner row of stakes, first in conjunction with a visible unit of measure and later basing their judgment on their recollection of its appearance.

This exercise is repeated at such longer ranges as the terrain affords up to 1,000 yards.

So far, all estimates have been made from the standing position. In combat the necessities of concealment and defilade will make the prone position the habitual one, hence the corresponding necessity of becoming adept at estimating distances in that position.

The foregoing exercises are therefore repeated, the soldier making all his estimates from the prone position.

Up to this point only open level ground has been used, this being the foundation or basis for all future progress in the estimation of distances.

It now remains to repeat these exercises under as great a variety of conditions as the terrain and the climate will afford. The soldier should be made familiar with the appearance of the unit of measure on bright, sunny days, and on overcast days; in rain, fog, or snow; on ground that is rising, falling, even, or undulating; over ground that is plowed, bare, grassy, or covered with brush; in fact, under every conceivable condition or combination of conditions that might surround a fire fight.

111. **Second stage.**—Up to this time it has been the endeavor to impress upon the soldier's memory the appearance of the unit of measure under all possible conditions.

In the second stage of instruction he is required to apply this knowledge in the determination of unknown distances.

Fifth exercise.—The instructor selects an observation point from which a wide arc of vision may be had.

He picks out some prominent landmark about 300 to 600 yards distant and points it out to the men, explaining that they are now to apply their knowledge of the appearance of the unit of measure in determining the range to this object.

He further explains that, in order to make this estimate, it is necessary to recall to the memory the appearance of the unit of measure and to apply this unit to the ground in the same manner that a ruler is applied in the measurement of short lengths.

He then cautions the men against the malpractice of attempting to judge of the distance to an object by its appearance only, although it is well, should time admit, to use the appearance of the object as a check against the unit-of-measure system.

He further explains to the men that, in the use of the unit-of-measure system, the objective is to be considered merely as in-

dicating the *direction* of the line upon which the estimate is to be made and as the *limit* to which the estimate is to extend.

The instructor then adds such remarks as may apply to the special peculiarities of the ground that is to be measured and explains that it is necessary for the soldier first to pick out some point in the direction of the objective that he considers to be 100 yards distant; then to pick out a second point 100 yards beyond the first; then a third point 100 yards beyond the second, and so on until the objective is reached.

The men are now directed to estimate the distance to the objective, to write their estimates on a piece of paper, and, without communicating their decisions to each other, to turn in the written estimates to the instructor.

Unless the instructor has had the true ranges measured before the exercise begins, he should adopt some speedy and accurate means of determining these distances such as a large scale map or with a range finder. If time must be taken to measure the true range with a chain or tape after each estimate, the enforced inactivity of the majority of the men is apt to cause their interest to lag, with the result that much of the instructional value of the exercise is lost.

Speed is not sought in these first estimates. On the contrary, as much deliberation is allowed as may be required to insure results that are really estimates and not mere guesses.

When all the men have handed in their estimates the instructor announces the true range and enters into such explanation as he may deem necessary as to the amount and direction of unusual errors.

Additional objectives are then selected and the same procedure repeated.

When the men begin to exhibit a reasonable degree of accuracy then speed is sought and the practice continued from day to day until the desired standard of proficiency is attained.

In the selection of objectives it would be well at this stage of the training to include some that resemble the targets that would be encountered in combat.

112. *Collective estimating.*—The training of an organization in the estimation of distances is not complete until the leaders (and those individuals who, in the exigencies of a campaign, might be called upon to act as leaders), are able quickly to take advantage of the combined estimates of some or all of the individuals under their command.

It is of little moment what system is used, so long as it is simple and uniform in the organization.

The following system is suggested as meeting these requirements:

Let two good estimators in each squad estimate the distance and signal their estimates to their respective squad leaders. The squad leaders (mentally) average the two estimates that they receive and signal these averages to their respective platoon leaders. The platoon leaders (mentally) average the mean estimates that they receive from their squad leaders and then signal these averages to the company commander. The company commander then averages the two means that he receives from the platoon leaders and announces the result as the range to be used.

It will be noted that by the use of this system no single leader is called upon to obtain the mean of more than two quantities, a comparatively simple task in mental arithmetic. And yet, finally, the company receives the means of 16 estimates as the range to be used.

In the training of leaders and prospective leaders in the subject of collective estimating, it is well to remember that it is the eye and not the ear that is to be trained, i. e., that the estimated ranges usually will be *signaled* to the leaders rather than communicated to them by word of mouth.

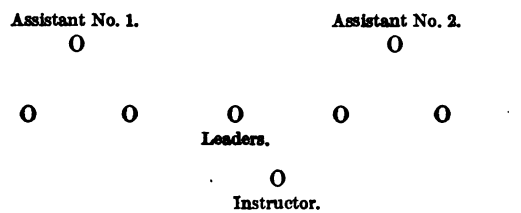
The preliminary exercises in this subject are nothing more than a form of mental gymnastics. For example, some such exercise as the following might be used:

The instructor assigns two men as assistants and furnishes each with a paper on which a series of assumed ranges are noted, thus—

	To No. 1 assistant.	To No. 2 assistant.
1	600	800
2	600	700
3	600	400
4	600	500
5	700	800
6	900	700
7	700	500
	etc.	etc.

The two assistants, standing about 5 or 10 yards apart, face the instructor at a distance of about 25 yards. The leaders

undergoing instruction are in line at convenient intervals facing the assistants at a distance of about 15 yards, thus—



The instructor calls to the assistants, "Range No. 1." No. 1 assistant would then signal "600," while No. 2 assistant would signal "800." The leaders then determine the mean of these two quantities and, facing about, signal their results to the instructor.

At first there should be an appreciable interval between the time that the range is signaled by assistant No. 1 and the time when it is signaled by No. 2. As progress is made, however, this interval of time gradually may be reduced until finally both assistants signal their ranges at the same time.

In similar manner, the instructor first demands absolute accuracy in the announcement of the mean ranges, speed being sought later but never at the expense of accuracy.

113. Leaders may be considered proficient in this work when, in the prone position, they can receive two ranges by signal, determine the mean accurately, and transmit that mean by an intelligible signal in a reasonable time.

An organization may be considered proficient when, in the prone position, ranges are estimated by individuals in the firing line, transmitted by signal through squad and platoon leaders to the company commander, an accurate mean announced by him that shall not differ from the true range by more than 10 per cent, sights are set according to the range announced by the company commander, and all this in a reasonable time.

To carry such a system farther, means could be devised to the end that each unit (squad and platoon) in the organization should it happen to be acting alone, could use easily and quickly the average of the estimates of its six or eight most skillful estimators.

Doubtless there will be occasions, in the preliminary stages of an attack as well as during the preparation of defensive works, when there will be ample time to assemble the skillful

estimators of a company and obtain the mean of their estimates without recourse to the channel of squad and platoon leaders. On such occasions, however, the necessity for estimating the distance probably will be lacking, for, as a general rule, instruments will be available for this purpose. In the preparation of defensive works, it even would be feasible to pace or actually to measure the distance on the ground before contact with the enemy had been established.

The individual proficiency test is prescribed in paragraph 85, S. A. F. M.

114. (*a*) **Range estimators.**—The estimating test having been completed, five or six officers or men, selected from the most accurate estimators in the company, are designated "Range estimators." (240, I. D. R., and 86, S. A. F. M.)

Platoon leaders, by reason of their duties, are not suitable for detail as range estimators.

The range estimators are given special training in the estimation of ranges up to 2,000 yards.

115. The following is illustrative of the manner in which the range estimators should work.

Assuming an attack against a prepared position, the captain having received orders as to the primary apportionment of the target or sector of fire (303, I. D. R.), he assembles the platoon leaders and range estimators and points out to both the target of the battalion and company.

The range estimators immediately begin their estimation of the range to the company target; the captain meanwhile continues with his instructions to the platoon leaders.

The instructions to the platoon leaders completed, the range estimators announce to the captain either their individual estimates or the mean of their estimates as computed by one of the estimators. The range estimators then take their customary posts (240, I. D. R.) and the captain indicates to the platoon leaders the range to be used.

The range estimators act in an advisory capacity to the captain. The mean of their estimates will usually be the most accurate range available in battle. The adoption by the captain of the range thus determined, however, is not obligatory.

Range estimators should be ready to signal their estimates of the range to the platoon leaders at any time during an action.

Thorough training of range estimators is to be sought, irrespective of the fact that the organization may be supplied with accurate range-finding instruments.

EXERCISE.

116. I.—**Object**: Determination of range by eye.

Method: (*a*) Each organization commander will be accompanied by his "range estimators." When called to the estimating point, the organization commander will be shown a line somewhere upon which will be stationed a squad with a flag. At a signal from the officer in charge the squad will rise and its flag conspicuously displayed. The officer undergoing the test will then estimate the range in the manner contemplated in paragraph 240, I. D. R. When he has found the range he will call "Time" and announce the range. Five ranges will be determined in this manner.

Time: Fifty seconds is the limit in which the range may be announced, counting from the appearance of the flag to the announcement of the range.

Standard of proficiency: Accuracy, 90 per cent.

117. (*b*) **Taking the range from a map.**—At the effective ranges of the small-arms projectile it rarely will be practicable to scale the distances directly from the map. Infantry ranges usually are so short in comparison to the scale of such maps as generally would be available to the company commander in the field that it is most difficult to measure them with the required degree of accuracy. It should be remembered also that the minute details of the terrain, by which the position of the guns and that of the enemy might be identified, usually will not be found on a small-scale map, while, on the other hand, experienced troops will avoid locating themselves in the vicinity of prominent landmarks, such as might be shown on a map of this character.

In the rare instances when a company commander has a large-scale map available the determination of ranges from it is merely a matter of reading the map.

Training in this phase of the determination of ranges might be taken up with most profit in connection with instruction in the subject of topography.

118. (*c*) **Obtaining the range from troops already engaged.**—This is merely a matter of inquiry on the part of the company commander of the nearest leader whom he finds on the firing line. This inquiry may be verbal or by the signals prescribed in the Drill Regulations.

119. (*d*) **Measuring the range directly on the ground.**—The distance on the ground may be measured by (1) the use of a tape or chain, (2) the pacing of horse or man, or (3) the instruments of precision of the engineer.

It is obvious that none of these methods are practicable except on the defensive when ample time is available before the possibility of contact with the enemy.

Training in this, as in the use of maps for the determination of ranges, may be had in connection with the instruction in topography.

120. (*e*) **Estimating distance by sound.**—On this subject the Small Arms Firing Manual states:

"Sound travels at the rate of 1,100 feet, or 366 yards, per second. If a gun is fired at a distance a certain time elapses before the sound is heard. If the number of seconds or parts of seconds between the flash and the report be carefully taken and multiplied by 366, the product will be approximately the distance in yards to the gun. Lacking special instruments of precision, this method will be of doubtful use on the battle field, owing to the difficulty of distinguishing the sound of the gun, whose flash is seen, from that of any other. It will probably be useful in determining the range to a hostile battery when it first opens fire." (Par. 82.)

121. (*f*) **Range finders.**—Training in the use of range-finding instruments depends upon the type of instrument that is supplied to the organization. Pamphlets describing these instruments are issued with them.

In the training of an organization in the use of range finders it should be the endeavor not only to train the particular individuals who are designated to use it, but also a number of others who should be perfectly competent to take the place of the "range taker" should he become a casualty in action.

Exercises should cover adjustments for height and distance, measuring ranges, and the preparation of range cards.

EXERCISE.

122. I.—**Object:** Determination of ranges with the range finder.

Method: The battalion range takers are taken to the point from which the ranges are to be taken. Instruments out of adjustment. They will each, independently of the others, determine and announce the range. Ranges should be determined as quickly as possible, but accuracy must not be sacrificed.

Time: Record kept for each man, for information of the officer in charge only.

Standard of proficiency: Accuracy, 90 per cent.

RANGE CARDS AND RANGE MARKS.

123. Range card.—A range card is a device for giving ranges to various points in a field of fire for use in attack or defense. Range cards should be prepared by organization commanders for their own use and for use by platoon leaders and observers. When possible, the best way to prepare a range card is to use a piece of a large-scale map of the country on which to draw the range circles and direction lines. There will usually be more

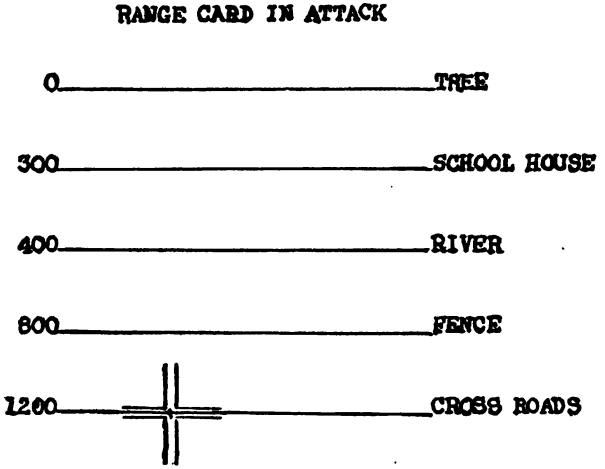


FIG. 23.—Simple range card for attack.

time for preparing range cards in defense than in attack and consequently range cards prepared for defensive positions will, as a rule, be more elaborate than those made for use in attack.

124. A simple range card for attack.—Figure 23 shows a rough example of a simple range card made for use in attack. The ranges are taken from the crossroads at X to a series of prominent objects on or a little to either side of the line of advance. The distance of each of these points *from the enemy's position* is carefully noted, and thus ranging during the attack is greatly facilitated.

NOTE.—The point from which ranges are taken should always be described clearly on the card to facilitate orientation.

125. A simple range card for defense.—Figure 24 is an example of a range card for use in defense. The ranges in this case are supposed to be taken from a point "A" immediately south of the church. The direction line from "A" to the church is heavier than the other line to facilitate orienting the range card in the same manner as a map. When the card is oriented for the point from which ranges are taken—which is noted on the card—by pointing the thick direction line on the church, the other direction lines will indicate the ranges to other points

RANGE CARD IN DEFENSE

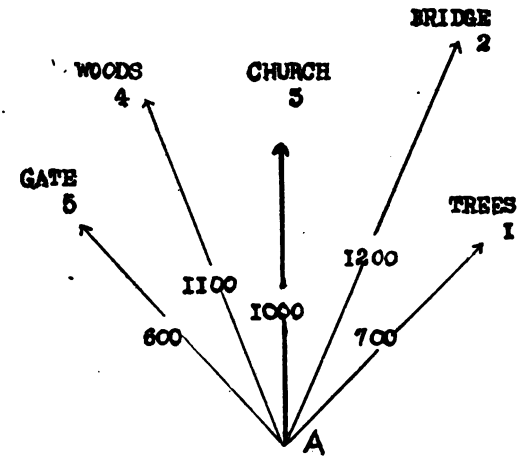


FIG. 24.—Simple range card for defense.

marked on the card. Each point registered on the range card is numbered consecutively from right to left.

The actual marking of ranges on the ground by means of visible marks may be by providing range marks and placing them on the side of large trees, houses, banks, small folds in the ground, etc., only visible to the defense.

126. Ranging.—When other conditions are favorable and the ground in the vicinity of the enemy is such as to give visible signs of the strike of the bullets, the range may be determined by firing trial or ranging volleys.

The determination of the range by firing volleys is practicable only when:

(1) The terrain in the vicinity of the target is visible.

(2) The target itself is stationary.

(3) The ground or surface is such that the strike of the bullets can be observed.

(4) The firing party is not under heavy fire.

(5) The time is available.

(6) The observer is trained.

As but a few of these conditions are likely to be found, this method of determining the range is of rare utility.

In determining the range by volleys, assuming two platoons, one platoon sets its sight at a range of 200 yards *under* the

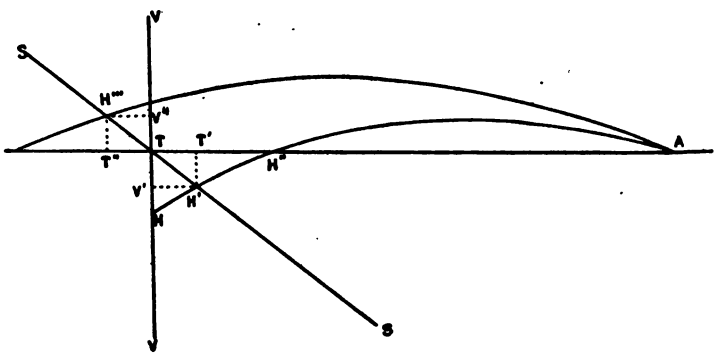


FIG. 25.

estimated range and the other 200 yards *over* with a view to bracketing the target.

The terrain near the target must be visible, otherwise there is nothing upon which to base an estimate of the change. In other words, the ground must be rising with respect to the line of site.

127. The correction of sights, as a result of ranging, is based upon the observation of the impact and the subsequent estimate as to its distance and direction from the objective.

In known distance practice, the strike of the bullet is on a vertical surface, and, when the position is shown by the marking disk, the sight is corrected accordingly.

In combat, however, as the observation of impact is usually on a surface that is rising with respect to the line of site, the

correction of the sight must compensate not only for the horizontal distance short or over, but also for the vertical distance above or below the objective.

In figure 25 suppose *VV* to represent a vertical surface and the point *T* to be the target. If a shot fired at *T* strikes at the point *H*, the sight correction to be applied corresponds to the vertical distance *HT*. If *T* be assumed to be on a horizontal surface *AT*, the same trajectory will cut the horizontal surface at *H''* and the sight correction to be made will correspond to the horizontal distance *H''T*. If *T* be assumed to be on the surface *STS*, rising with respect to the line of site, the same trajectory will intersect this sloping surface at the point *H'*. The required correction in this case embodies two elements, a correction for the horizontal distance short, *H'V'*, and a correction for the vertical distance below the target, represented by *H'T'*.

Similarly, the correction to be applied to a shot that is over is represented by the distance *H''' T'''* plus *H''' V'''*.

From the above it is obvious that when the target is on sloping ground the correction applied to the rear sight will be too small unless, in addition to the correction for the actual distance short or over, allowance is made also for the angular distance of the point of impact above or below the target.

In practice, the actual distance in yards that the center of impact is distant from the target must, in most cases, be estimated. The vertical correction, however, may be measured with a fair degree of accuracy by using the type *EE* field glass with the range and mil scale or else the musketry rule.

To measure the amount of this vertical correction with either the glass or the ruler place the graduation of the range scale corresponding to the elevation actually used, in coincidence with the target. Then the graduation opposite the point where the impact was noted will be the elevation necessary to take in order to correct for the vertical error. It is to be noted that this vertical correction gives the range (in terms of the sight) to the point of impact.

The vertical correction having been made, then the correction is completed by adding (if the impact is short) or subtracting (if the impact is over) a number of yards equal to the estimate of the horizontal distance from the impact to the objective and setting the sight accordingly. (Fig. 26.)

Assume the range to have been estimated at 800 yards. Then, with the 800-yard graduation held opposite the target, the splash of impact is observed opposite the 1,100-yard graduation and is estimated to be 150 yards short. The full correction,

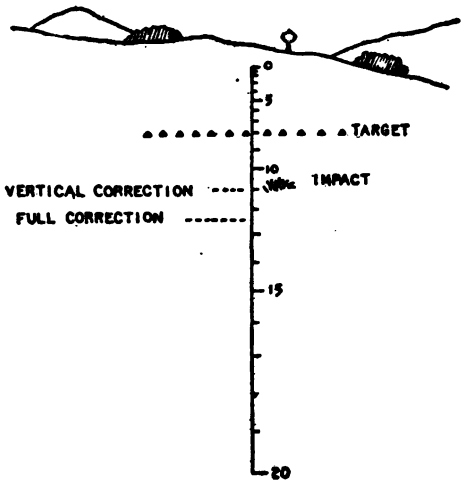


FIG. 26.

therefore, would be 1,100 yards (vertical correction) plus 150 yards (horizontal correction), or a final elevation of 1,250 yards, as a result of this observation.

128. The terrain should be visible, both in front and rear of the target.

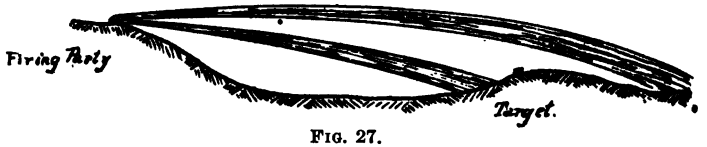


FIG. 27.

Indications will be only partial when the objective is along the crest, as shown in figure 27. The same will be true when the objective occupies the near edge of a woods or is along a hedge which completely screens from view the ground in rear of it.

An objective is difficult to adjust upon when it occupies one of a succession of parallel ridges, the ground appearing from

the firing point as a continuous surface. In such cases the only indications will come from shots which strike the ridges, those falling in the depressions being lost. From such indications wrong conclusions may be drawn unless the formation of the ground is discovered.

129. Ranging at moving targets is possible only when the objective can not materially change its course. Such targets are wagon trains or artillery in column on a road.

The ground surface must be such that the strike of the bullet can be observed.

The best indication is given by the bullets striking in loose, dry sandy soil.

In the fall of the year when the grass is dead the bullets will usually knock up enough dust from the grass to be visible.

In noting the strike of the shots it should be remembered that the dust will be seen somewhat above the actual point of impact and to the right or left, depending upon the direction of the wind.

A perfect condition will not as a rule be realized. The ground may be wet or covered with turf, sod, tall grass, or brush, in which case the indications may be entirely lacking or else so slight as to form no basis of judgment.

When the surface of the ground is such as not to furnish any indication to an observer at the firing point of the effect of fire the correctness of the rear-sight elevation may sometimes be inferred by careful observation of the actions or movements of the enemy.

It is manifest that definite results are not possible when the firing party is under heavy fire.

Time must be available and the observer must be trained.

The observer must be acquainted with the appearance and dimensions of the shot group as it will appear on various surfaces in order to recognize the center of impact, and he must have had some experience in the observation of fire.

To the untrained eye there will be a continuous space from front to rear of the target that is covered with bullets—that is, the center of the shot groups (the center of impact) of the two separate volleys will not be apparent.

Ground rising with respect to the line of site produces a shortening effect on the shot group. Rising slopes of less than one degree will not ordinarily give very positive results.

When the indications of impact are sufficient to form a basis of judgment it may be stated as a rough rule that the fire will be properly adjusted when about one-third of the shots of a trial volley appear to strike in front and two-thirds in rear, it being remembered that the direct hits will pass through and strike in rear of the target.

Let it be assumed that the bullets fall about as shown in figure 28.

It is apparent that there are a few bullets that have fallen between the center of impact of both groups, but there is a distinct center of impact to each volley, and in this case the center of the upper one being at 100 yards over the new range to be used would be about 100 yards less than the upper, the amount dependent upon the degree of slope.

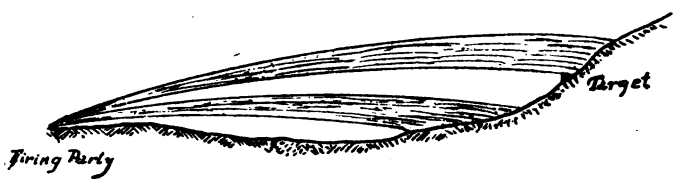


FIG. 28.

130. Not more than two trial volleys should be required for fire adjustment, and as soon as the range is determined a change should be made at once to "Fire at will" at a rate suited to the range and the visibility of the target. In making rear-sight corrections it is necessary to make positive changes. It is an insufficient and faulty procedure to attempt to correct adjustment through indefinite instructions, such as directing the men to aim a "little lower" or a "little higher." Habitual practice on favorable ground may tend to cultivate too great a dependence on signs of impact for making rear-sight corrections. This must be guarded against. Even on favorable ground, where large numbers of troops are engaged, it will be difficult, if not impossible, for commanders and leaders to distinguish indications of their own fire from that of other troops.

However partial or imperfect the signs of impact, close observation should be resorted to in every case, as slight indications may sometimes furnish a basis for rear-sight corrections.

Good field glasses are indispensable for observing the effect of fire, and the necessary skill in their use, through which cor-

rect conclusions may be drawn, is to be acquired only through practice.

Observation from the flanks or from a point above the firing party will often be possible. Such a position is far preferable to one at the line of the firers, as observation is facilitated and the accuracy of the corrections is increased. To an observer on or behind a flank of the firers, shots which pass over the target will appear to fall toward the flank on which the observer is posted. Those shots which drop short will appear to fall toward the other flank. Therefore if the greatest number of shots seem, to an observer on the right flank, to fall to the right of the target the sight setting being used is too great, and if they seem to fall to the left the sight setting is too small.

CHAPTER VIII.

FIRE DISTRIBUTION.

131. The combined fire of an organization must necessarily be either concentrated or distributed. In concentrated fire the men all use the same sight setting and aim at the same point. This class of fire is favorable for observation and has great effect but only at one spot. (The distribution of fire over the entire target is of special importance—240, I. D. R.).

Fire may be distributed either in depth or width.

The object of distribution in depth (combined sights—par. 52) is to increase the length of the beaten zone from front to rear.

Distribution in width is for the purpose of keeping all parts of the enemy's line under such an effective fire that no part of

FIG. 29.

that line can fire undisturbed. Therefore fire distribution is an essential to the gaining of fire superiority.

132. Distribution is both individual and collective. The individual soldier fires at that part of his platoon or squad target which corresponds to his position in the platoon or squad.

The combined result of the platoon or squad fire is a line of individual shot groups, each overlapping the one adjoining, the whole making the squad or platoon.

Proper fire distribution means that all of the target and not part of it is kept under fire. This is not as easy as one might think, and the attainment of proficiency necessitates much practice on the part of leaders and men.

133. In the original deployment for battle, the division commander assigns to his brigades a part of the general front or objective in such manner that the division's objective is all covered.

These brigade fronts are subdivided again down through the regiments to battalions, companies, and platoons.

The division of the objective into parts and the assignment to units must be made with great care. If the adjacent flanks of two organizations advancing from slightly different directions guide on the same point in the enemy's line during the advance, they will arrive in a continuous line upon its front. If the point is in advance of the line, there will be crowding and overlapping. This is objectionable, as it causes confusion and may subject one portion of the line to the fire of the other. Casualties during the advance may tend to reduce this difficulty.

If the guiding point is in rear of the enemy's line, there will be a gap between the two organizations, which, however, may be filled, if desirable. If two organizations are advancing in the same direction, contiguous to each other (as in a purely frontal attack), no difficulty is encountered. This is the simplest form of attack.

The higher the commander the easier the subdivision of his target. The leaders of smaller units, battalions, companies, and platoons have the difficult task.

134. The battalion commander must describe the targets to his captains in such terms that there will be no chance of a misunderstanding.

The drill regulations prescribe that the major designate:

(*a*) The direction of the advance or,

(*b*) The objective for each company of his battalion in the firing line or,

(*c*) The position of the enemy or,

(*d*) The general object to be obtained and the special problem for each company, and

(*e*) The order and front of each company,

(*f*) The right or left company as the base company.

The above are principles which are comparatively easy to state. Their practical application to concrete cases is not always so simple.

Taking the first—that of giving the direction of attack.

Von Kiesling gives a problem where a railroad runs through the enemy's lines. The battalion front extends to one side of the railroad. The major directs—

"Nos. 1 and 2 companies will be in the front line, No. 1 company will be on the right with its right on the road and will connect with No. 2 company, which will be on the left. Frontage of each company, 150 meters (165 yards)." (P. 53, Operation orders.) Frequently nothing more will be possible.

In this problem, of course, each and every man is a trained soldier and fires on that part of the target directly in front of him.

An imaginary line to some physical object that can be seen back of the line may be taken at times as the guiding line.

135. Generally it will be sufficient with trained troops to acquaint them with the width of the sector in defense or front of the troops in attack, assuming that it is not desired to follow

BN. IN ATTACK AS PART OF LARGER FORCE SHOWING PLATOON FRONTS.

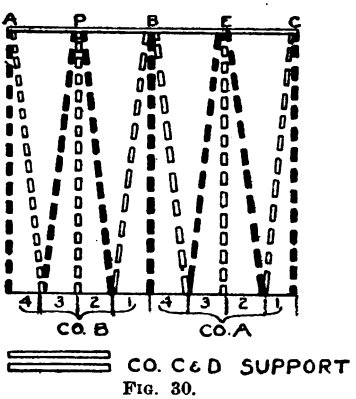


FIG. 30.

prearranged and obvious system of apportionment, as where each company takes its proportion of the whole target depending upon the number of companies in the line. (303, I. D. R.)

Assuming that, in a given situation, the major commanding a battalion, as a part of a large force, has been given a front or part of the enemy's line *A–C* to attack, he might divide his target as shown in figure 30, putting two companies in the firing line and two in support.

The captains then subdivide their target as shown, assuming four platoons. Company A: The first and second platoons each cover *E–C*. Third and fourth platoons each *B–E*. This is known as the overlapping method, and where one of these pla-

toons ceases fire to advance, the other, having the same objective or part, replaces the lost rifles by increasing its rate of fire. With three platoons the company front is divided into two parts, one is assigned to each flank platoon and the whole company front to the center platoon. With two platoons each takes the whole company objective.

136. There is another system known as the **switch method.**

The company objective is divided into a number of parts, one less than the number of platoons in the company. One platoon is designated as the switch platoon. Thus with four platoons and assuming platoon rushes to start from the right, the company objective is divided into three parts, assigned to the first, second, and third platoons, the fourth being the "switch." Number 1 ceases fire to advance, No. 4 fires at No. 1's target, No. 2 ceases fire to advance, No. 4 fires at No. 2's target, then at No. 3's target, and finally No. 4 advances. This method is not approved, as it can only be used by troops exceptionally well in hand.

No attempt is made to assign the squads to parts of the target any more than to have the squads take as their target the part of the platoon's target that corresponds to the squad's position in the platoon. This is all that will be possible under the ordinary conditions of an attack.

The foregoing gives the theoretical method. No rule can be made in the abstract that will apply to all concrete cases.

137. The use of reference points and the mil rule (par. 92) should eliminate most of the difficulties in the distribution of the target. (See Designation and Recognition of Service Targets.)

This implies facility on the part of the major and all officers in the conversion of mils into yards, fingers, and rear sight.

The best possible designation of the target must be made.

In moving from one position to another, and after the target has been assigned, it must be kept under constant observation, care being exercised to guard against the apparent shifting of the target when viewed from some point other than that at which it was first pointed out. It must be remembered that objects viewed from different angles do not always look the same.

For instance, in case 1, figure 31, the captain from his position at 0, and in the manner described, points out the target to the lieutenant of the left platoon. The lieutenant moves to point

X without making any measurement or paying any particular attention to the target. At point X he assigns the target to his platoon, but the left of the platoon is assigned to the foot of the trees. Twenty mils of the company target to the left of the tree is not covered.

Had he, the lieutenant, found the point C in the line, or with his mil rule measured off 100 mils from the foot of the tree while with the captain and picked up the point A in the line, he could have moved to X observing the point C constantly, or measured off 100 mils from A as seen from his new position, and he would have had the entire target covered as in case 2. By this method of keeping the target constantly under observation and measuring off the distance in the manner indicated, errors in reassignment of targets may be avoided.

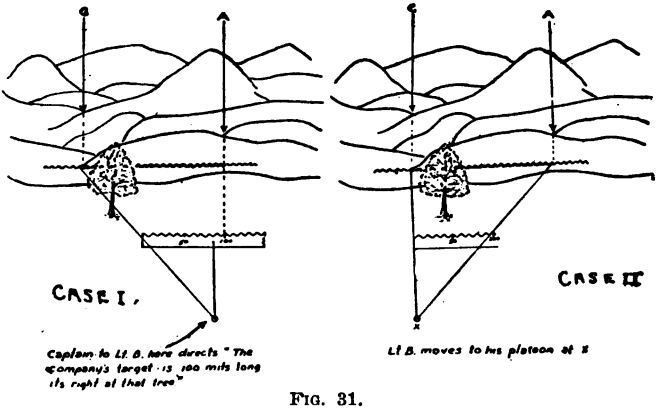

CASE I.
Captain to Lt. B. here directs "The company's target is 100 mils long its right at that tree"
CASE II
Lt B. moves to his platoon at X

FIG. 31.

138. In defense.—In apportioning the battalion target to the companies on the firing line, the difference between the battalion in attack and defense should be noted. In defense the division of the battalion sector should be made with reference to physical objects, if possible. This has reference to the fire sector which is not to be confused with the actual amount of ground the battalion trenches cover. An order to one of the companies might be something like the following: "Company C, with its right resting on this point [indicated on the ground], will intrench on a front of 100 yards, covering the sector from the railroad, inclusive, to the tree [both indicated on the ground], exclusively, crossing fire with the battalion on our right and with Company B on its left." (Fig. 32.)

The men must be trained not to slight invisible portions of the target.

139. Exercises in target distribution.—It is assumed that all are accustomed to measuring widths by the use of the mil scale, rear sight, and the use of reference points.

I.—Object: To teach fire leaders the apportionment of the target, determination of the range by the use of range estimators, and the issuance of fire orders.

Method: The targets for these exercises may be either represented, outlined, or assumed. When represented or outlined, either men or silhouettes may be used for the purpose. The limits of the objective are indicated by flags, and may include the entire line or only a portion of it.

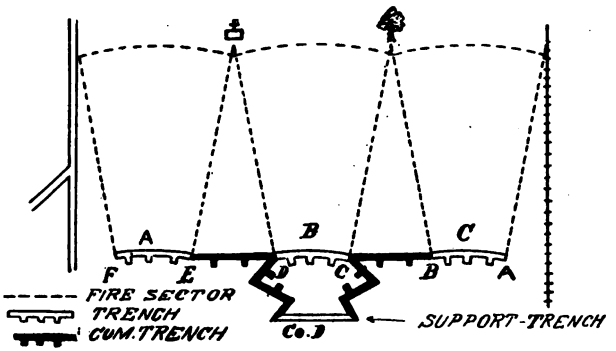


FIG. 32.

The unit represented by the platoon and squad leaders is halted at some point from which it is not possible to obtain a view of the target. The instructor calls the leader forward to a point from which the target is visible and at the same time causes the flags to be displayed at the target. He points out the target to the leader and informs him that the flags mark the flanks of his objective. The instructor further informs the leader that these flags will be removed before his unit is permitted to come within view of the target and that therefore the flanks of the objective must be fixed in the mind by reference to natural landmarks. When the leader informs the instructor that he has the target definitely located with reference to natural landmarks, the latter causes the flags to be removed.

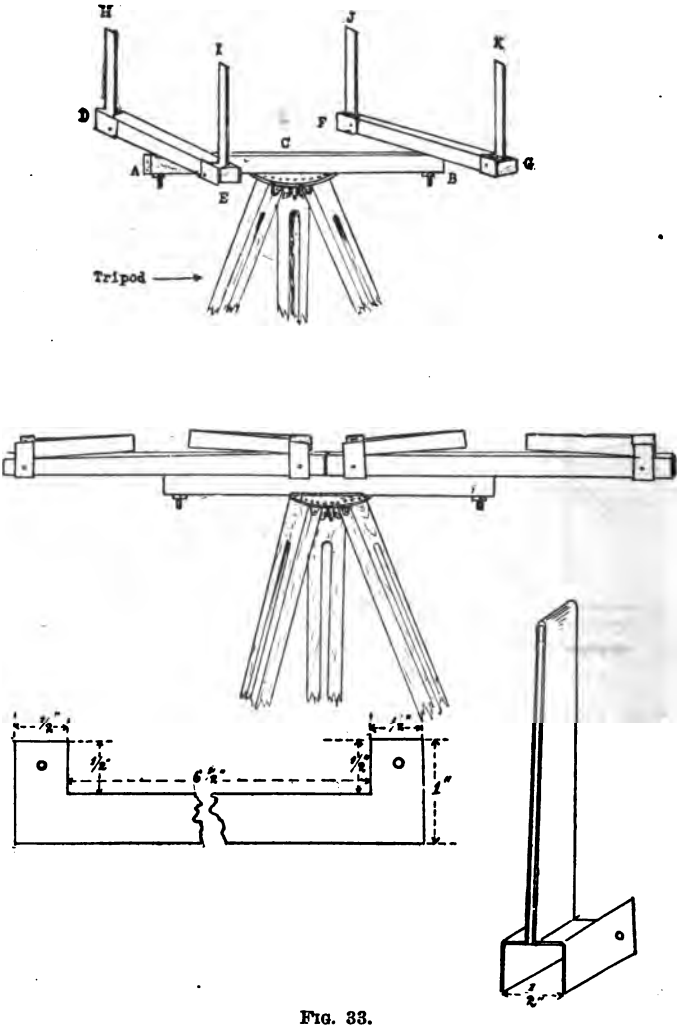


FIG. 33.

The leader is now directed to complete his reconnaissance of the position, to occupy it with his unit, and to issue his fire order—all this under the assumption that his mission requires this target to be taken under fire. The instructor may add further conditions to the problem, as, for example, that the fire must be opened without delay, that the position is or is not under hostile fire.

The leader then issues his fire order (pars. 255–260) in a manner that would be feasible under the assumed conditions of the problem.

Each subordinate commander in turn issues his fire order in a similar manner.

When the fire orders have been issued, each leader (by use of the aiming tripod, figs. 33–34) indicates what he believes to be the limits of the objective or of the fraction of the objective upon which he has been ordered to direct his fire.

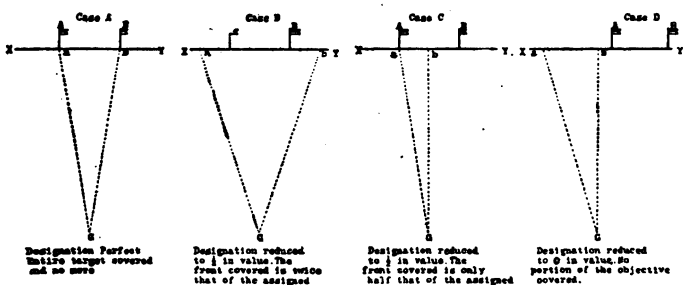


FIG. 34.

This being done, the instructor causes the flags again to be displayed at the target, verifies the sighting of the aiming tripods, checks the elevations used with the true range to the objective, and then gives a critique on the execution of the exercise.

140. *The aiming tripod heretofore mentioned is made as follows:* Referring to figure 33A, the base, AB, and the arms, DE and FG, are made of hardwood. They are each about ½ inch square in cross section and about 10 inches in length.

At its center the base is made fast to the tripod (any camera or sketching tripod is satisfactory for this purpose) by a bolt and wing nut at G.

This point is made loose enough to permit of the base being turned in a horizontal plane without undue muscular exertion, but there must still be sufficient friction at this point to prevent the base being turned on the tripod by the action of a strong wind.

In like manner the arms are fastened to the ends of the base at A and B, the pivot of the arms being about ½ an inch off the center to permit of the device being folded as shown in figure 33B.

The pointers, HD, IE, JF, and KG, may be made of any available pieces of thin sheet metal—zinc, copper, brass, tin, etc.

The shape and size of these pointers, as cut from the flat metal sheet, are as shown in figure 33C. This piece is then bent in the shape shown in figure 33D.

These pointers are riveted to the ends of the arms in such manner as to permit of their being placed in an upright position for use, figure 33A, or folded down for packing or transportation, figure 33B.

In use the tripod is set up with the base approximately perpendicular to the line of fire. When the leader has received his fire order, he decides upon what he believes to be the location of his target, and then, using the pointers as front and rear sights, directs the arm DE at the point which marks the right flank of his particular fraction of the objective, while the arm FG is similarly directed at the left flank.

In judging of the execution of any particular exercise, the instructor takes into account the probable material effect of the fire, assuming it to have been carried out in strict compliance with the fire order. (Chap. XVIII, pars. 255–261.)

141. It is not sufficient for the instructor to state that the range is in error by a certain amount. He should observe the manner in which the range was determined and decide whether this method would have been practicable under the assumed conditions; point out the possible or probable causes of error; show how these errors may be eliminated or at least reduced in amount; and state whether the error is or is not excessive.

The instructor next turns his attention to the manner in which the target has been designated and to the precision of direction and control resulting from this designation.

The instructor's conclusions as to the correctness or incorrectness of the designation are based on his own observation of the manner in which the leader and his subordinates issue their fire

orders. The perfection of distribution is verified by the aiming tripod.

Referring to figure 34, let *XY* be the line of targets, and *A* and *B* be the flags marking the flanks of the particular fraction of that line at which fire is to be directed. Let *G* represent the position of the gunner or leader, and the lines *Ga* and *Gb* represent the two lines of aim as shown by the arms of aiming tripod.

Case A shows that the designation and the understanding of the designation were perfect, the arms of the aiming tripod pointing with precision at the flanks of the target.

Cases B and C show that the designation or the understanding of it (the instructor determines by observation whether the error lies with the leader or the subordinate), is lacking in accuracy to such an extent as to reduce the effect of the fire by one-half; in case B because twice the allotted front is covered and hence the assigned target received but half of the volume of fire that should have been directed upon it; in case C but half of the target is covered with fire.

In case D no credit whatever can be allowed for designation, as there is no portion of the target that is covered with fire.

By showing how the effect of fire is reduced by the combined errors in range and designation, the instructor may give a forcible demonstration of the fact that the best marksmanship is of no avail if acting under the direction of a faulty fire order.

Take case B for example and assume that the true range of 800 yards was estimated at 900 yards. From the table (par. 105) it is found that this error will reduce the hits from 100 to 50. As only half of the fire is directed at the target these 50 hits would also be reduced by one-half. Hence good marksmen, who are capable of making 100 hits on the target if properly directed, make only 25 hits because of the errors of their leaders.

This exercise may be varied in several ways.

One variation is to point out the target to the leader and then require him to occupy a position several hundred yards nearer the objective and there issue his fire order.

A second variation is similar to the first except that the new position is well off to one flank as well as to the front.

Advantage of this exercise may be taken to instruct the men in distribution and also in not slighting invisible portions of the target for more prominent parts.

For this purpose a part of the assigned target should be only partially visible. The fire leaders give the orders, indicating target to be covered, etc., and the men align their rifles, using sandbags or other improvised rests, or the aiming tripod.

The alignment of the rifles is then verified by the instructor, and usually at first it will be found that none of the rifles are aimed at that part of the line which is partially concealed.

At this point it should be explained to the men that the enemy's men occupying that part of the line at which their rifles were not aimed represent a part of the enemy's line that is not disturbed at all, as no one is firing at them. As a result they will do just as good shooting as on the target range.

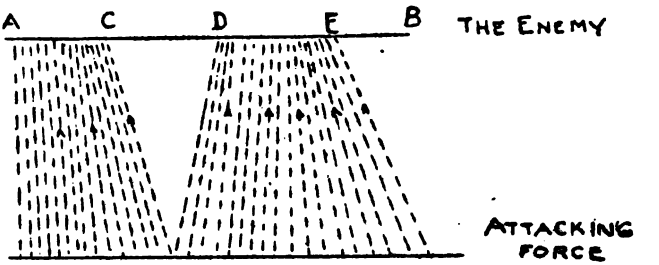


FIG. 35.

It can be readily seen that if the enemy holds the line *A–B*, figure 35, and the attacking force keeps *A–C* and *DE* only under fire, that that part of the enemy *C–D* and *EB* will do good execution.

II.—**Object**: As for first exercise tactical walk.

Method: Assume the target assigned to the colonel. Give the colonel's attack order, then the major's, carrying this down to the platoon leaders of one or more platoons.

FIG. 36.

These designations should always be made at the same distance from the target that they would be made were a real enemy there. Two or three men should act as subordinates to determine whether or not the subdivision is understood.

III.—**Object**: To teach, "Men are so instructed that each fires on that part of the target which is directly opposite him" (245 I. D. R.), or, in other words, the individual fires at that

part of his platoon or squad target which corresponds to his position in that platoon.

Method: Make a frame 3 by 6 feet on the order of an A target frame. Cover this frame with target cloth and then paste thereon blank paper. Ordinary yellow wrapping paper will answer the purpose. Paste a row of black target pasters about 4 inches from the bottom edge of the target, as in figure 36.

Sandbag rests are provided at the firing point for the rifles.

The individual soldier is then called to the firing point and told that his squad or platoon is firing at a line of the enemy, represented by the row of black pasters on the target, and that he is No. 3, front rank, or some other number, of the first, second, third, or fourth squad of his platoon. He is then directed to sight his rifle at that part of the line at which he thinks he should fire, using the sandbag. The instructor then verifies the sighting.

For convenience in verifying the pasters may be numbered in pencil in such manner as not to be visible to the soldier at the firing point.

This target may be used by the squad actually firing and using the gallery rifle and .22 ammunition. The corporal is given a part or the whole of the target to cover; he then gives his fire order and the squad fires. The distribution is verified by the hits.

CHAPTER IX.

AUXILIARY AIMING TARGETS.

142. If the target can not be seen with the naked eye, platoon leaders select an object in front of, or behind it, designate this as the aiming target, and direct a sight setting which will carry the cone of fire into the target. (Par. 247, I. D. R.)

THE RANGE SCALE FOR USE WITH THE AUXILIARY TARGETS.

This is the reversed and reduced reproduction of the graduations of the rear sight leaf of the rifle. The theory upon which this device is constructed will be understood by reference to figure 37.

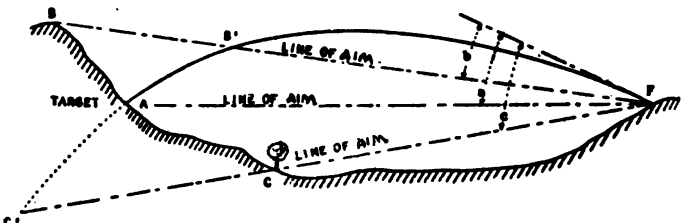


FIG 37.

143. The illustration shows a cross section through two hill features with the firer at *F* and the target at *A* (1,000 yards distant from *F*). It also shows two possible aiming points at *B* and at *C* and the trajectory necessary to hit the target at *A*.

Case 1.—The target at *A* is clearly visible. The rifle is therefore aimed directly at the target with sight setting 1,000 yards. The line of aim is the line *F*–*A*, the angle of departure is the angle *a* and the trajectory is the line *F*–*B'*–*A* which the bullet travels and so strikes the target at *A*, as intended. No matter what auxiliary target is used, the bullet will travel this same trajectory and strike at *A* when the appropriate sight setting is used.

Case 2.—The target *A* is invisible except through glasses. Aim can not now be taken at the target and an auxiliary aiming

target is necessary. At *C* is a well-defined point. If the rifle is aimed at *C* the desired trajectory will be produced when the angle of departure is *c*, the line of aim *F–C*, the sight setting on the sight is equal to *F–C'*.

Case 3.—The target at *A* is invisible and the sky line at *B* is chosen as an aiming target. If the rifle is aimed at *B* with an elevation *b*, the line of aim will be *F–B*, the angle of departure will be *b*, and the bullet will travel along the trajectory *F–B'–A*, passing the line of aim at the range *F–B'* and striking the target at *A*, as desired.

USE OF THE MUSKETRY RULE TO OBTAIN SIGHT SETTING TO BE USED WITH AUXILIARY AIMING TARGET.

144. An auxiliary aiming target having been chosen, approximately in line with the target and above or below it, an estimate or measurement of the range to the *target* is made. Both sliders on the musketry rule are then set to this range. The rule is held so that the zero is up and the distance of 15 inches is obtained by means of the cord and knot. (Par. 78.) If the aiming target is above the target, the upper slider is now moved up until both the target and the aiming target can just be seen through the gap between the sliders. The scale reading opposite the upper slider is that to be set on the rifle sights of the firers if they are to aim at the auxiliary aiming target and expect to hit the target. If the aiming target is below the target, the procedure is the same, except that the lower slide is moved down until both the aiming target and target are visible. The sight setting for the firers is then that opposite the lower slider.

The rule of thumb for this operation is: Aiming target *beyond* target elevation to be used *less* than that for direct aim; aiming target nearer than target, elevation to be used *greater* than for direct aim.

CHOICE OF AN AIMING TARGET.

145. The choice of an aiming target depends primarily on the available features of the terrain that are immediately in line with the area that is to be covered with fire. At ordinary ranges care must be taken not to choose an aiming target so that a minus sight setting will result. Sky lines are often not available on this account. Assuming that the enemy's line to

be covered with fire is of the same length as the attacking line, there are three satisfactory aiming targets from a theoretical standpoint.

First, an aiming target consisting of a point so far in rear of the enemy's line (several miles) that the fire will be slightly convergent. In this case the distribution and accuracy of fire should be excellent, but if the aiming target is too close the flanks of the enemy will not be covered.

Second, an aiming target consisting of a well defined horizontal *line* within 100 yards or so of the enemy's line. In this case the accuracy of fire should be excellent.

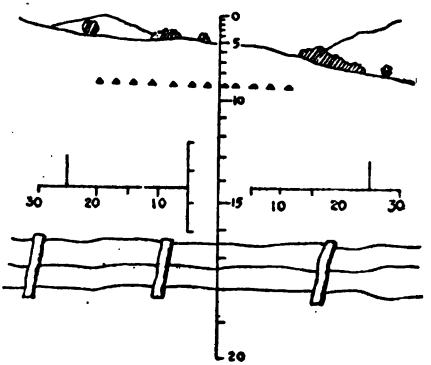


FIG. 38.

Third, an aiming target consisting of a point half way between the firing line and the enemy, so that the fire crosses at the aiming target. Then the fire of the right flank strikes the enemy's right flank. In this case the accuracy and distribution should both be excellent, but here, again, if the aiming target is not exactly half way to the enemy the fire may cover too much or too little of the enemy's line.

146. Considerable judgment and experience is required in the choice of aiming targets. Excellent results may be obtained by their judicious use, but they should rarely if ever be used if the real target is visible to the firing line.

Figure 38 shows the use of the field glass in designating an auxiliary aiming target.

All men must understand that they are to take just as careful aim and hold just as carefully when using an aiming target as when firing at the actual target. Otherwise they can not expect their fire to be effective.

All officers and noncommissioned officers should have practical instruction in the selection and designation of auxiliary aiming targets. This is well taught by means of terrain exercises. The enemy is outlined by suitable field targets. The men under instruction select an aiming target, determining the range to be used, etc., and write their data on slips of paper of convenient size. These slips are then taken up by the instructor and read and criticized on the spot.

CHAPTER X.

BATTLE-FIELD COMMUNICATION.

147. The Signal Corps furnishes electrical communication, supplemented by other means, down to and including brigade headquarters.

Communication within the brigade is ordinarily by means of visual signals, written or verbal messages, and, except in position and siege warfare, seldom by electrical means.

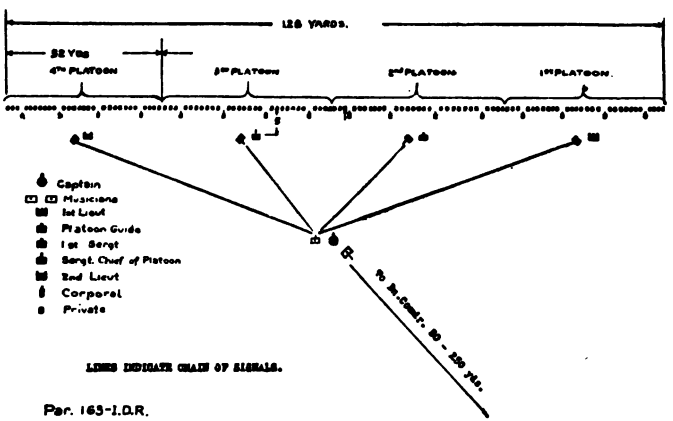


FIG. 39.

The personnel for this duty within the brigade is furnished by the troops themselves.

Paragraph 1562, A. R., requires that at least two men in each organization be proficient in visual signaling. The number of qualified signalists in a company or troop should by no means be limited by these provisions. As many men as possible should be qualified in the general service code (wigwag) and

In sending and receiving messages by semaphore.
In delivering short verbal messages.
In transmitting firing data.
In using the prescribed battle-field signals (41–47, I. D. R.).
In the duties of messengers.

148. Figure 39 illustrates the chain of battle-field signals and the channels for the transmission of commands within the battalion. The training of the battalion must be such that this chain is not interrupted by casualties. All signals are repeated back to prevent errors.

It is to be noted that the men responsible for maintenance of this communication do not necessarily face continuously in the direction indicated by the points, as they are also charged with other duties; but **they do look in that direction instantly at the sound of the whistle "Attention,"** and at other times they frequently glance in that direction.

MESSENGERS.

149. The occasion will be rare when verbal messages may be carried on the battle field in the attack. However, the importance of this feature of a soldier's training is so apparent and it is so closely related to musketry that the following short paragraph on verbal messages is included:

VERBAL MESSAGES.

150. *Verbal messages should always be brief*, and, if sent by other than a staff officer, be limited to the minimum number of items. The messenger should repeat the message before starting and understand what he is to carry. Within the regiment the distance over which messengers will move will usually be short. If the messages are brief and clear-cut, like telegrams, there should be little confusion.

The messenger must be instructed specifically as to whom he will deliver the message, and whether or not there is a reply.

A verbal message which is the subject of a fatal change in sense by the omission of one word should be avoided. For example:

"The support will not move north of Cache Creek."

This message is subject to a reversal in meaning by the omission of "not," and should read:

"The support will halt south of Cache Creek."

The verbal message should include the address and the name of the sender, for example:

"To Capt. Jones,
"Halt south of Cache Creek.
"From Col. Smith."

After delivering the message, the messenger will ask if there is a reply. Unless otherwise instructed, he will return to the sending authority and deliver the reply, or report the message delivered and that there was no reply.

DUTIES OF MESSENGERS.

151. (1) Keeps himself informed as far as possible as to the location of the headquarters of the units to which communication is maintained, both to the rear and front.

(2) Studies and notes the best routes to the various units.

(3) Before starting with the message, asks the following questions if not clear:

(*a*) What is the official designation of the person to whom I am to deliver the message?

(*b*) Where is this person?

(*c*) What is the nearest and shortest way there? Or, can I be given a map of the route?

(*d*) Is there an answer?

(*e*) Am I to report back as soon as the message is delivered? If not, to whom shall I report?

(4) Important messages in writing, unless confidential, should be understood by the bearer so that they may be delivered verbally if the written message is destroyed to prevent the information falling into the hands of the enemy.

(5) Always repeat a verbal message word for word to the sender before starting. Be sure to understand the meaning. Do not attempt to merely memorize the words, but beware of false interpretation.

(6) The envelope containing the message will bear:

(*a*) Address; complete location of addressee not given or entirely omitted. The organization to which the addressee belongs should not be included in the address if it is possible to identify him in some other manner, as "C. O., advance guard," "C. O., outpost."

(*b*) The name of the messenger.

(*c*) Date and hour of departure.

(*d*) Rate of speed. Do not use the terms ordinary, rapid, urgent; instead tell the mounted messenger either to walk, to walk and trot, to trot, to trot and gallop, to gallop, or to go at top speed. Tell the dismounted messenger either to walk, to double time, or to run.

(*e*) If mounted and given a written message to deliver on which the speed is not indicated, ask for it. This constitutes an important safeguard to the messenger. With verbal messages a messenger usually receives instructions as to speed; if in doubt, ask.

(7) On reaching destination, call out "Message for." After intelligent search, if the person to whom the message is sent can not be found, try to find some other person who can take full advantage of the information. Whether or not this can be done, always report back to the sender all facts in the case.

(8) Ask if there is a reply.

(9) If the recipient fails to do so, request that the envelope be initialed or signed and the time and date be recorded thereon.

(10) If aware of the nature of the message and you know of any circumstances affecting the situation which may have arisen since you left the sender, report the circumstances after delivering the message.

(11) *Always* report back to the sender, stating whether or not the message was delivered, transmitting the answer, if any.

(12) When a messenger carries a message unsealed or not marked "Confidential" he will permit commanders along the route to read same. Each commander so doing will initial or sign the envelope and record thereon the date and exact time he reads the message. The messenger will request, if necessary, that this be done.

(13) Written messages in danger of falling into the hands of the enemy may be sent in code.

EXERCISES TO TEACH COMMUNICATION AND THE USE OF SIGNALS.

152. I.—**Object:** To teach the wigwag.

Method: The wigwag is easily taught by taking the letters up in groups in the order of—

Dot letters.
Dash letters.
Dot-dash letters.
Dash-dot letters.
Mixed letters.

153. II.—**Object:** To teach the semaphore.

Method: Teach the semaphore in the following groups as a part of calisthenics:

A, B, C, D, E, F, and G.

K, L, M, N, P, Q, R, and S.

T, U, Y, signals, letters, J, and V.

H, I, O, W, X, and Z.

Opposite letters, A—G, B—F, H—Z, I—X, J—P, K—V, O—W.

Opposite letters, M—S, Q—Y, T—letters, L—signals, N—U.

154. III.—**Object:** To teach the men to deliver short verbal messages.

Method: Form the squad in single rank. The instructor gives a simple verbal message to the man on the extreme right (or left) of the line to be passed down the line to the man on the other flank. This is repeated at odd times, while resting at drill, waiting for assembly, etc., until the men become proficient.

155. IV.—**Object:** To teach the transmission of firing data rapidly and accurately and without decreasing the rate of fire.

Method: A squad or platoon is deployed at two-pace intervals and given certain firing data; the men simulate firing. A second squad or platoon is then deployed and reinforces the first, the men taking their places in the intervals between the men already firing. Without changing the rate of fire the men originally on the line transmit to the new men the firing data. Thirty seconds after the reinforcements join the line the original firing party is withdrawn. Sight setting and the understanding of the target is then checked.

This exercise may be varied by giving certain firing data to a flank man and direct its transmission through the squad.

156. V.—**Object:** To teach the prescribed signals. (41–47, I. D. R.)

Method: The squad or platoon in line. A signal is made by the instructor and the men are called upon to tell what it means. As progress is made a command is given and the men are told to make the signals. This practice may be had at odd times, while the men are resting, waiting for formations, etc.

After the signals are learned officers should conduct all battle practice, extended order, etc., by signals only. If during instruction the men have been accustomed to depend on the use of signals they may be expected to respond to them on the battlefield.

Do not devise a lot of additional signals. Those given in the I. D. R. are ample.

Here it is well to note that the semaphore is not suitable for the signals prescribed by paragraph 47, I. D. R.

157. VI.—Object: To train an organization in such manner that the chain of command and leadership will not be interrupted by casualties.

Method: The company or battalion in a combat exercise. Certain leaders, designated beforehand, drop out at irregular intervals as the exercise develops as dead men. The next in rank should take the place of the dead man and complete the exercise. The men dropping out as dead make no sign and do not leave the field until the exercise is terminated.

CHAPTER XI.

THE USE OF COVER.

158. The recruit should be given careful instruction in the individual use of cover.

It should be impressed upon him that, in taking advantage of natural cover, he must be able to fire easily and effectively upon the enemy; if advancing on an enemy, he must do so steadily and as rapidly as possible; he must conceal himself as much as possible while firing and while advancing. While setting his sight he should be under cover or lying prone.

To teach him to fire easily and effectively, at the same time concealing himself from the view of the enemy, he is practiced in simulated firing in the prone, sitting, kneeling, and crouching positions, from behind hillocks, trees, heaps of earth or rocks, from depressions, gullies, ditches, doorways, or windows. He is taught to fire around the right side of his concealment whenever possible, or, when this is not possible, to rise enough to fire over the top of his concealment.

When these details are understood, he is required to select cover with reference to an assumed enemy and to place himself behind it in proper position for firing. (152, 153, I. D. R.)

159. There are two kinds of cover: (1) Cover from view only; (2) cover that is bullet proof.

It is absolutely essential that every man should learn what cover is bullet proof, and how he can best get protection behind it. It is certain that in war hundreds of lives are lost through men hiding behind small trees, thin banks of earth, and similar cover.

160. The following rules as to bullet-proof cover should be impressed upon all men:

(*a*) Most kinds of earth, a rifle's length thick, will stop bullets.

(*b*) A tree usually turns a bullet—few are large enough to stop one, unless squarely hit.

(*c*) Wooden walls and boards are scarcely ever thick enough to stop bullets.

(*d*) A fence or wall of brick or stone will usually stop a bullet. Walls and fences, however, are likely to be shelled.

The men should understand that certain cover not only does not furnish protection against rifle fire, but is dangerous.

Isolated bushes or clumps of undergrowth which do not afford protection from fire are dangerous if occupied in view of the enemy, because they offer clearly defined targets, and the concealment they give is of no value if the enemy knows they are occupied.

Rocks may also be dangerous on account of the liability of men being injured by fragments.

Hedges, banks, and walls give the enemy a good aiming target and may obstruct the advance of troops.

Loss of fire effect must not be sacrificed to cover from view. It is also preferable to lie in the open than to stop behind cover which offers a good target but which does not protect from fire.

The men must be taught to crawl, to fire from all positions—behind trees, doorways, and small folds in the ground.

161. Crawling.—(Grenadier says:) It is much more difficult to crawl well than would at first be supposed.

It is quite certain that the men will at first think that there is nothing to be learned about crawling.

It is very desirable to demonstrate to the men how important good crawling may be a comparatively safe means of covering ground, when to run would be exceedingly dangerous.

To give a good demonstration, choose a piece of almost flat ground, with a few slight undulations in it.

Before the platoon arrives, try to find a fold in the ground from which part of the field is not visible, even if one crawled forward a few yards.

Choose a position for the platoon so that if lying down the men of it would not be able to see a man lying in this fold of ground. There are few fields so flat that it is not possible to hide even a whole company somewhere in them, if the men lie quite flat.

March the platoon to the selected place. Point out to the men that the field appears almost flat and that it would seem difficult to conceal anyone in it.

Then make the platoon lie down, facing the fold in the ground. Detach four or five men and take them to the further side of the hollow. Let them advance toward the platoon, but as soon as they enter the fold in the ground make them throw themselves flat, and let them crawl forward, keeping as close to the ground

as possible. This should make clear to the platoon the great possibilities in crawling.

Now practice the men in crawling. If the ground is damp, men can practice indoor.

To offer the least possible mark when crawling a man—

(1) Should lie absolutely flat, with his elbows to the front, his wrists under his chin. His back should be hollow.

(2) To advance he should bring one knee forward, keeping the *inside of the knee* flat to the ground and his back hollow. *Above everything he must not draw this knee under him.*

He must then push himself forward with this leg, helping his progress with his elbows.

In good crawling a man presents scarcely more of a target when moving than when stationary.

FIG. 40.

Most rifle bullets in war go too high.

A line of men, when crawling, presents a very poor target to rifle fire.

Almost every bullet will pass over their heads.

By night a company might well crawl to within a few yards of the enemy without suffering any loss.

FIRING FROM COVER.

162. Firing from cover is best taught by practical illustration. Half of the squad or platoon alternate in taking the firing positions behind cover. The men not taking position observe. Errors are corrected, and the men are impressed with the importance of reducing the size target they present to the enemy and at the same time being able to fire effectively.

Figure 40 illustrates the correct position firing from a fold in the ground. Note the excellent position of the man behind the tree.

In figure 41 note the incorrect position of the man on the extreme left—too much exposure.

FIG. 41.

A right-handed man should always fire from the right side of a tree and the left side of an open door or window.

FIG. 42.

In figure 43 note the incorrect position—firing from left side of the tree.

COVER FROM SHELL FIRE.

163. It is explained to the men that most shells fall at a steeper angle than does a bullet and that shells either burst on the ground or in the air. Cover from those that burst on the ground can only be obtained by means of a hole or trench. Anything that will stop a bullet will stop fragments or bullets from a shell that bursts in the air.

Houses that can not be seen by the enemy may furnish protection against shell fragments. The lower rooms are the safer, as the roof is ordinarily not of sufficient thickness to stop any-

FIG. 43.

thing. Houses which the enemy can see are death traps and to be avoided. To obtain cover from a bullet is rather easy, as its trajectory is fairly flat, like the rays of a searchlight. To escape from pieces or fragments of bursting shells is much harder, and to do so one must lie very close to the cover, as they fall almost vertically, like rain.

It is to be noted that the pack carried on the back renders a great deal of protection against bursting fragments when the men are in the prone position. In the early stages of the present war and before the introduction of the steel helmet many men placed the small intrenching shovel on the pack in such manner as to give them, when in the prone position in the open, a great deal of protection for the back of their necks and heads.

CHAPTER XII.

BATTLE-FIELD RECONNAISSANCE AND THE SELECTION OF FIRING POSITIONS.

164. For the purpose of study, battle-field reconnaissance may be divided into two closely related parts. Battle reconnaissance furnishes information of the terrain and the enemy; combat reconnaissance deals with the security of the command during the advance and engagement.

165. The regimental objective is divided between the battalions on the firing line.

From the colonel the major receives information of the hostile position, intervening terrain, the general situation, proposed plan of action, and the limits of the battalion objective. By battle-field reconnaissance the major acquires the accurate knowledge of the hostile lines and the intervening terrain essential to his conduct of the attack. He will thus guard against premature deployment, avoid hostile fire while in dense formations, and attempt to arrive within effective range of the enemy before opening fire.

166. All attacks may be considered under three heads:

1. When there is a delay in the face of the enemy—a few hours to several days—permitting thorough exploration of the battlefield terrain.

2. When the attack is immediate. In this case the functions of the battle reconnaissance and combat patrols may be merged in the same individuals, or the two patrols may advance together.

3. Infinite degrees of blending of the above two situations.

The true attack commences after the advancing firing line has reached the firing position marked by the combat patrols.

167. Battle reconnaissance explores the ground to be traversed by a unit advancing to an attack. This subject covers the route, fire positions, targets, and includes all information desirable for a commander to receive before moving forward to an unknown position.

168. Combat reconnaissance guards the advance against surprise, clears the way to the positions desired, and protects the flanks.

A battle-reconnaissance patrol seeking information on the eve of an engagement may become, by its position, a combat patrol and provide the necessary security to the flank and front during the ensuing action.

When the major begins the advance upon the enemy, in pursuance of his orders, he must provide for the reconnaissance in his own immediate front—and flanks if necessary—to avoid unexpected encounters with the enemy. This security is provided during the early stages of the advance by patrols. According to their instructions, the flank patrols may become the combat patrols of the fire fight, as responsibility for the flanks does not cease with the opening of fire. The patrols to the front advance through the zone of artillery fire, press on to within effective range for musketry, under 1,000 yards (307, I. D. R.), select and, when possible, occupy and outline the first position of the firing line. The strength and number of these patrols is determined by the terrain. In open country one patrol per company on the firing line might suffice to precede the line of skirmishers. If the terrain be broken or covered with vegetation, several patrols may be required. In many cases it will be necessary to cover the battalion front with a thin skirmish line of selected men sent forward to develop the hostile lines, select firing positions, and cover the advance of the firing line. It may be necessary to fight for this information.

169. Battle reconnaissance requires training in map reading, recognition of important military features on the terrain, and sketching.

BATTLE RECONNAISSANCE PERSONNEL AND TRAINING.

Battle reconnaissance is a part of the subject of security and information, but is strictly limited to the work done when in the proximity of the enemy and possibly in contact with him.

Except when necessary to drive back hostile detachments, the battle reconnaissance patrol will be small—one, two, or seldom more than three men. Officers will frequently be utilized. These patrols receive their instructions either from the major or from the captains acting under specific instructions from the major.

This duty of battle reconnaissance calls for special training, courage, good judgment, and initiative on the part of the individual. Proficiency is required in visual signaling and in sending verbal and written messages.

170. The equipment for men on this duty is that prescribed for any patrol leader—compass, musketry rule, watch, pencils, notebook, field-message blanks, and, when practicable, a map of the countrty.

The special training essential to the proper performance of this important duty includes—

(*a*) Map reading for sectors, routes, and firing positions.

(*b*) Reconnaissance of the terrain for routes, sectors, firing positions, targets, and reports thereon.

(*c*) Sketching.

171. The area covered in battle reconnaissance by any one patrol will usually be a rectangle lying between the battalion front and the section of the enemy's line assigned the battalion as an objective. The terrain to be reconnoitered by each battalion will thus be a rectangle with a maximum length of about 3 miles and a maximum breadth of 500 yards. When the battalion sector is on a flank the territory will be extended on that side to a distance not exceeding 1,000 yards, or to include the terrain covered by the combat patrols.

The battalion acting alone is charged with the reconnaissance of its front and both flanks. But in this case much of the work to the flanks will be done by patrols preceding the engagement.

The battle reconnaissance patrols study and report on—

(1) The best route to the firing positions.

(2) Firing positions.

(3) The targets commanded by the firing positions.

172. Routes.—A route through the zone of hostile fire, artillery and small arms, to the firing position within effective range should permit approach without detection by the enemy and be free from any serious obstacles which might hinder the advance.

The following points should be considered in choosing the route, all of which can be shown on a route sketch, using marginal notes:

A. *Footing.*—A route off the roads where the ground is smooth and hard avoids objectionable features connected with the use of trails and roads.

(*a*) A trail may cause troops to march in columns of twos or files, but is often the most practicable route.

(*b*) Road: (1) Avoid roads leading toward enemy. They are sure to be under observation and fire and are where troops are expected. (2) Hostile artillery will have data and ranges to reference points previously located in anticipation of targets appearing on roads. (3) Movements on roads may disclose, by dust clouds, position of columns otherwise hidden.

B. *Deflade.*—The route should be protected from hostile observation and fire by utilizing:

(*a*) The dead space behind hills.

(*b*) Deep creek bottoms and sunken roads.

(*c*) Woods or other high vegetation.

C. *Exposed zones.*—A route should avoid exposed areas when possible. If such areas must be traversed, routes will be located so that proper formations for crossing can be taken prior to emerging from the last cover. Areas where uniforms blend with the terrain may be crossed with little loss.

D. *Areas concealed* from view of the enemy may be enfiladed by hostile fire, providing the enemy has an observer in the air or on some commanding position to direct the fire. Report will therefore be made of any aircraft observed and the location of any points from which hostile observers may note an advance through the sector.

E. *Streams.*—It is desirable that no streams be crossed that are difficult to ford. If streams must be crossed, avoid, if possible, established bridges and fords. Report direction of flow, depth and character of bottom, height and character of banks.

F. *Obstacles.*—Routes should avoid any serious natural or artificial obstacle to the advance.

Natural obstacles include:

1. Cliffs, difficult slopes, ravines.
2. Bogs, deep water.
3. Cactus or other impeding vegetation.

Artificial obstacles:

1. Specially constructed obstacles.
2. Thorny hedges.
3. Wire fences.
4. Pits, ditches.

G. The route should not bring the column in view of enemy near a prominent object that may serve as hostile registration or aiming point.

173. Firing positions.—A knowledge of features constituting an ideal firing position for attack or for defense is essential in battle reconnaissance.

The following constitute the features to be sought in firing positions and included in a verbal or written report:

A position having all these advantages will be found rarely, if ever. The one should be selected which conforms the closest to the description, remembering that the position is chosen for its suitability for use as a *fire position* rather than for its suitability as *cover*.

174. ***Firing position—Attack*** (152, 406, 407, 450, I. D. R.):

1. Clear field of fire.
2. Within effective range of enemy.
3. Length of front sufficient to accommodate command.
4. Ground should permit constant observation of the enemy and yet enable the men to secure some cover when not actually firing.
5. Not marked by any objects the range to which may be known to the enemy. Hedges, fences, and sky lines are particularly to be avoided.
6. Can be approached under cover.
7. Presents no difficulties to further advance.
8. Flanks not enfiladed.

175. ***Firing position—Defense*** (489, I. D. R.):

1. Clear field of fire.

Grenadier says: "A favorable field of fire should extend about 300 yards to the front. Before this war 800 yards would have been considered ideal.

"The reason for this change of opinion are these: If on Monday morning you had a field of fire of 800 yards, the Germans would crawl up close to you on Monday night and entrench themselves, so that by Tuesday morning you would only have a field of fire of 300 yards.

"There is another most important reason: The German artillery fire from concealed positions, and their fire (as they can not see you) is directed by telephone by an officer near their infantry firing line.

"If your field of fire is 800 yards, their officer at that range can see your trenches and direct fire upon them. But if your field of fire is 300 yards he will, to do this, have to approach so close to you that he can not safely carry out his duty, so that you will suffer less from artillery fire.

"Also, if your field of fire is only 300 yards, the Germans to attack you must bring their infantry within this range.

"It will be very difficult for the German gunners to fire at your trenches for fear of shots, which go short, hitting their own men. So choose a field of fire from 150 to 350 yards.

"By night this can be done by sending out a noncommissioned officer the required distance. He will then show a flash lamp from below the level of his jacket toward the trench, and shield it from view in other directions as he would a match from the wind."

2. Length of front suitable to size of command.
3. Flanks secure.
4. Lateral communication.
5. Cover for supports and reserves.
6. A position the enemy can not avoid, but must attack or give up his mission.

The locations of *firing positions* are determined by taking prone observations at intervals along the lines under investigation. A position viewed from a standing position may appear ideal. The low command of the prone skirmisher is affected by tall grass, gentle folds in the ground, low-lying cactus, etc. Such features are accentuated only by the observer actually placing himself in the prone position and viewing the hostile target. The patrol leader is given the battalion objective before starting forward. Positions selected will be such that the enemy presents as favorable a target as possible.

The firing position selected should lie within effective range of the enemy—800 yards—if possible. The actual firing position should lie along the military crest facing the enemy. It may be necessary for the patrol to halt behind the crest of the ridge and reconnoiter the enemy from this position, although reporting the actual firing position farther to the front.

Natural or cultural features which offer clearly defined targets for the enemy's fire and afford no protection from its effects are to be avoided, especially if they must be occupied in view of the enemy.

176. Reconnaissance at night.—The terrain to be covered during a night operation should be reconnoitered both by day and in the darkness by trained men, who will act as guides during the movement.

Battle reconnaissance covers the exploration of the battalion sector for certain military features after the advance against the enemy has been ordered by the higher commander.

Reconnoitering at night may be closely related to battle reconnaissance. *An attack at daybreak must be carefully planned* beforehand. The terrain must be thoroughly patrolled, and the different units, including the battalions, assigned their areas, and each will move forward through at least a portion of the battalion sector in separate columns.

The orders for an attack at daylight will not be published generally until the actual movement forward is inaugurated. The majors, under their confidential orders, however, will send forward patrols specially trained in battle reconnaissance to study the terrain within the battalion sector with special reference to the night advance. These patrols are instructed regarding the secrecy of their movements. An attack delivered at daybreak necessitates *an advance during* what are often *the darkest hours of the night*, with the possibility of its interruption by a counter attack at any time.

The first and most important step in the preparation of any night operation consists in obtaining accurate information concerning the ground to be traversed and the position of the enemy. This necessitates as close a reconnaissance as is possible, and the reconnaissance should be made by night as well as by day. Ground presents such a different appearance at night that it is often difficult to identify a spot which has been seen previously in daylight. Small incidents of the surface which may not attract attention in daytime are sometimes sufficient to throw troops into disorder if encountered unexpectedly in the dark.

Every possible precaution must be taken to prevent an accidental collision between any two columns either before or after reaching their objectives. Bloody encounters between friendly forces meeting unexpectedly in the dark are not infrequent in history.

177. *Night advances will be preceded and guided by selected men* who have reconnoitered the ground both by day and at night. These "guides" will precede the column at distances varying from 50 to 100 yards, according to the light, contact being maintained by means of connecting files.

This duty of guiding columns at night will naturally devolve upon the selected officers and men trained in the important duty of battle reconnaissance.

The battle sector of a battalion is never of extensive breadth, and must be reconnoitered in the dark as well as by day. Whenever possible the day reconnaissance should precede the

night. The guide should be familiar with the identity of the north star and carry a compass with a luminous face.

The ability to move freely and with confidence through the dark is easily cultivated. With training men develop a keen sense of direction, and the more adventurous a liking for the work. With the development of modern firearms, especially artillery and machine guns, night advances if not night attacks may have great influence in the attainment of victory.

The officers and men who show the requisite qualities for battle reconnaissance, as well as other phases of the subject of security and information, should not fail to develop the ability to explore country at night. Such men are invaluable in guiding night advances.

178. The reports by a battle reconnaissance patrol will cover the routes, firing positions, targets, and all other military information of value to the commander of the firing line.

The reports made by a leader of a battle reconnaissance patrol will be in the form of visual messages; brief messages, written and verbal; sketches sent back by a member of his patrol; and a verbal or written report illustrated by route and landscape sketches.

When these patrols take the form of skirmishers at extended intervals, covering the advance of the firing line at a distance of from 100 to 1,000 yards, the *information* will be transmitted largely by *visual signals.* Brief messages of fact can be transmitted quickly by signals. For example, the presence of small hostile patrols, which are being driven back, may be indicated by holding the rifle over the head horizontally. (29, F. S. R.) This signal would explain any scattered firing. The *final report,* verbal or written, will detail the military features of the sector, covering the route, fire positions, targets, and ranges.

The patrol leader must understand clearly his mission. He must know what to look for, be able to describe intelligently what is seen, to locate what is seen with reference to features on the terrain, the time and place to make his report. In other words, *where* to go, *what* to look for, *how* to describe, *when* to report, and to *whom* to report.

The power of accurate observation is the result of training. Due largely to differences in their boyhood environment, this power varies greatly among recruits. A man raised in thinly settled country will naturally give close and careful attention to the entire landscape. Given judgment, keen eyesight, pres-

ence of mind and courage, such a man only requires instruction in the military matters to make an excellent patrol leader.

The messages and reports must be clear, concise, and accurate. The ability to paint a clear and accurate word picture of a section of country is, however, beyond the power of most men. It is no less difficult for the person receiving the report to form a mental picture of the country described.

Resort is had, therefore, to *sketches* to illustrate and supplement the report. A rough sketch with all distances estimated will usually convey more real information of military value than many words.

CHAPTER XIII.

FIRE TACTICS.

179. The Infantry Drill Regulations, paragraphs 351, 354, 400, and 401, says in part:

"Modern combat demands the highest order of training, discipline, leadership, and morale on the part of the infantry."

"The infantry must have the tenacity to hold every advantage gained, the individual and collective discipline and skill needed to master the enemy's fire, the determination to close with the enemy in attack, and to meet him with the bayonet in defense. * * * Good infantry can defeat an enemy greatly superior in numbers, but lacking in training, discipline, leadership, and morale."

"In a decisive battle success depends on gaining and maintaining fire superiority. Every effort must be made to gain it early and then to keep it.

"Attacking troops must first gain fire superiority in order to reach the hostile position. Over open ground attack is possible only when the attacking force has a decided fire superiority. With such superiority the attack is not only possible, but success is probable and without ruinous losses.

"Defending troops can prevent a charge only when they can master the enemy's fire and inflict heavy losses upon him."

"To obtain fire superiority it is necessary to produce a heavy volume of accurate fire. Every increase in the effectiveness of the fire means a corresponding decrease in the effectiveness of the enemy's fire."

180. Fire superiority means the attainment and continuance, by troops better trained, better controlled, and with a higher morale than the enemy, of such an effective fire over the enemy's lines as to shake his morale, causing him to aim imperfectly, if at all, and thereby destroy the effectiveness of his fire.

The gaining of fire superiority is dependent, among other things, upon:

(1) The troop leading (par. 181).
(2) The choice of target (par. 190).
(3) The distribution of fire (Chap. VIII).
(4) The density of firing lines (par. 192).
(5) The determination of the range (Chap. VII).
(6) The time of opening fire (par. 196).

(7) The kind of fire (par. 198).
(8) The rate and volume of fire (par. 207).
(9) The distance between echelons (par. 217).
(10) The service of observation of the enemy and of the effect of fire (par. 220).
(11) The ammunition supplies (Chap. XIV).

TROOP LEADING.

181. Troop leading is the technique of command.—The art of leadership consists in applying sound tactical principles to concrete cases on the battlefield.

"Self-reliance, initiative, aggressiveness, and a conception of teamwork are the fundamental characteristics of successful leadership." (358, I. D. R.)

Military education, through the performance of actual duties, is not sufficient to acquire a mastery of this subject. Theory must be combined with practice, and much of what is necessary to learn is common to the entire graduation of commanders, although the viewpoint is different from every round of the ladder.

To be a successful troop leader implies a thorough understanding of men, tactical principles and their application, and the requisite ability to issue orders to meet given situations as they may arise.

A knowledge of the psychological effect, of the effect that different orders under different conditions will produce upon the mind of the individual man, is of vital importance to the troop leader. *Maude* gives the attitude of the instructor in peace as follows:

"I tell you this now in peace, because there is time and I am teaching; in war there is no time. I receive orders and obey them unquestionably, because I have confidence in my chief and know that he has cards in his hands which I have not seen, and in turn you must then obey me until I fall and there is no one left to give you further instructions; then you must act for yourself, each according to his rank, in harmony with the general principles of the whole army."

182. Correct orders are possible only after an estimate of the situation has been made and a definite decision reached. Gen. Morrison says:

"The objection raised to the process or method of estimating the situation that it is too long except in map problems and that

in actual practice one must act more promptly is not well taken. It might be if it were contemplated to write the estimate all out, but this is not the case. The mind works rapidly in accustomed channels. The child beginning the study of arithmetic is very slow in determining the sum of 7, 8, and 9, but later the answer is announced almost at sight. The same is true of tactical problems; it may be a slow process at first, but with a little practice the decision is reached very quickly, is likely to be correct, and to be the one you will not want to change every few minutes. An accountant who guesses at the sum of a column of figures, instead of correctly adding them, would not be liable to make more errors than would a commander who failed to properly estimate the situation."

Material differences manifest themselves between the actions of small bodies acting independently and bodies in larger commands.

In all problems it is necessary to come to a clear and correct decision, do it promptly, and execute it vigorously. The decision is followed by the order.

183. The arrangement of the order, or sequence of its details, should follow some logical system.

The sequence of details given in the Field Service Regulations for tactical orders and that for fire orders herein (par. 255) follow such a logical system. These systems should not, as a rule, be departed from. In other words, a commander should be so in the habit of following this definite plan in the issuance of orders that he will be absolutely certain he is not omitting an important detail when acting under the mental strain incident to combat. It should be unnecessary to state that points which have no application to a particular situation are simply left out. The troop leader must have the quick military perception which enables him to give the necessary order to meet the particular situation which confronts him.

To instruct you must explain.

The division commander explains his views to his brigadiers, allotting to each his part in the general scheme of operations; the brigadiers, in turn, explain and distribute the work to their colonels, and so on down to the corporal and his squad, and in peace this is all possible.

In war it may be possible to go into this detail and it may not.

The officer who issues orders must weigh the time factor against all other circumstances surrounding the particular situation, and do it instantly.

A troop leader, in dealing with this time factor, must not only consider the necessity for rapidity of action to gain the initiative over the enemy but must also consider the actual time necessary for the issuance of correct orders. If he estimates that he has 10 minutes within which to issue his orders he must remember that his subordinate leaders are entitled to their proportional share of this time. He must not take eight minutes of the time and allow subordinates only two. It takes time to digest the order, to formulate and issue it to subordinates and for the subordinates, in turn, to comprehend and act upon it.

184. The order, written or verbal, must be as short and to the point as clearness will permit. Brevity must not, however, be secured at the expense of lucidity. The order of the leader of an advance party might, for instance, in a meeting engagement be simply "As skirmishers, guide right (left), 'March'; Battle sight, 'Fire at will,'" while that of a captain whose company is part of a larger force in a general attack against a prepared position might go into great detail. One must not forget that time, when available, spent in explanation is not lost. The rule should be to give all the information necessary to enable each and every one to play his part in the general scheme.

The order must above all things be clear, concise, and definite. There should be no possibility of a misunderstanding. Von Verdy says:

"The criterion of a good order will always be simplicity and clearness; if one word is stricken out of any good order it will become unintelligible; and any word that can be stricken out and still leave the order intelligible is superfluous and consequently harmful."

Most important of all in an order is that it be easily understood; the clearer it is the more remote is the possibility of a misunderstanding.

It is not an easy matter to issue a good order. It is an art that must be **acquired and practiced.**

The amount of detail given in an order depends upon the situation and the rank and training of the recipient.

185. Tasks must be definitely assigned. The comparatively wide fronts of deployed units increase the difficulties of control. A company commander with his company deployed on a front of 128 yards can not hope to exercise any control except through his platoon commanders and subordinates. Subordinates must therefore be given great latitude in the execution of their tasks.

The success of the whole depends upon how well each subordinate coordinates his work with the general plan. (371, I. D. R.)

186. The *latitude allowed officers* is in direct proportion to the size of their commands. Each should see to the general execution of his task, leaving to the proper subordinates the supervision of details and interfering only when mistakes are made that threaten to seriously prejudice the general plan. (370, I. D. R.)

At peace maneuvers the majors are everywhere, and the captains do the work of all platoon commanders. It is said, in justifying this action, that it is necessary for instruction and will be corrected by the first bullet. All should know that this is not true. As a man acts in peace so will he also act in war. *Habit* can not be changed by one bullet.

"When issuing orders a commander should indicate clearly what is to be done by each subordinate but not how it is to be done. He shoud not encroach upon the functions of a subordinate by prescribing details of execution unless he has good reason to doubt the ability or judgment of the subordinate and can not substitute others." (382, I. D. R.)

If clear and concise instructions are given as to the action to be taken in the combat by each part of the command, tasks, fronts, or sectors being assigned in accordance with a definite, simple plan, conveying definite ideas and leaving no loophole, the conduct of the subordinates will generally be correspondingly satisfactory.

187. Subordinate leaders, up to and including company commanders, are mainly occupied with fire control and fire direction, and should influence their men by their personal example; superior commanders have other tasks which they must not neglect for the purpose of interfering in the spheres of action of their subordinates. During the action the superior commander can influence its course only by employing his reserves.

The difficulties of troop leading increase as the power of the commander to control and direct all ranks in action by word of command decreases.

Those means must be adopted in action that will facilitate the transmission of orders. This requires, first of all, the choice of an appropriate position for the leader. The beginning of an action should find him as far forward as possible; during the advance to the battle field with the advance guard, for neither messages nor a map can adequately take the place

of a personal view of the enemy, of neighboring units, and of the ground. So placed he can best direct the first deployment upon which the future course of the action so largely depends, secure advantages by making prompt decisions in the face of the enemy, save his troops from making detours, handle them in accordance with a definite plan, and preclude arbitrary action on the part of the commander of the leading unit.

The post of the commander in action must be such as will enable him to observe the progress of events and to communicate his orders. After having announced where he will be during the action, he *should not quit that place without leaving some one there to direct messengers and others where to find him.*

188. A commander takes full and direct charge of his firing line only when that line has absorbed his whole command.

"Full and direct charge" is not to be construed that a major, when he sends in his last company, moves up close to the firing line and takes over the duties of the captains, determining the sizes of the elements to rush, how they will rush, etc. But it does mean that a major's duties have changed somewhat. Before the last company went into the line the major's position was back where he could observe the firing line and at the same time control the movement of the support and regulate the ammunition supply. After the last company is engaged he has no support to look after, and he moves up where he can insure the coordination and cooperation of his companies. At the same time he must be back far enough so that he can attend to his still important duties of regulating the ammunition supply and of directing any supports sent him from the reserve. He does not disturb the existing machinery of command, but does lend to the firing line the effect of his personal presence near the line and leads the charge of his battalion.

When the last element of the regiment goes into the line, the colonel moves up in the same way, as does the brigade commander with the last fraction of his brigade.

Certain qualities are necessary in the troops themselves before it is possible to lead them to victory. Assuming that they have been trained in the mechanics of their profession, there must be added the development of a true soldier spirit, of character, of loyalty to themselves, their comrades, and their superiors.

Loyalty is part of the soldier's creed and needs no discussion.

189. *Initiative* in a junior officer or noncommissioned officer is the adoption of the proper methods to carry out orders given him, or the acting in a manner different from that ordered when

it is found that due to conditions which were not considered when the original order was issued such action becomes necessary.

Manifestly to use initiative an officer and noncommissioned officer must be trained. No one would or could expect an officer, untrained in his profession, to act independently and still have his action fit in with the general plan except by accident, and accidents of this kind are too rare, even improbable, for a commander to consider in forming his plans.

To the company officer and noncommissioned officer initiative in the fire fight means the correct utilization of the means in his hands, men and rifles, to increase the probability of the force to which he belongs gaining fire superiority and the resultant victory. His action must be such that it fits in with the general plan.

THE CHOICE OF TARGET.

190. The target chosen should be the hostile troops most dangerous to the firers. These will usually be the nearest hostile infantry. When no target is especially dangerous, that one should be chosen which promises the most hits.

Frequent changes of target impair the fire effect. Unimportant targets impair fire discipline and accomplish nothing. Attention should be confined to the main target until substantial reason for change is apparent.

An opportunity for delivering flanking fire, especially against artillery protected in front by shields, is an example warranting change of target, and should never be overlooked. Such fire demoralizes the troops subjected to it, even if the losses inflicted are small. In this manner a relatively small number of rifles can produce important results. (408–410, I. D. R.)

Each unit in the attack is assigned a definite frontage or objective. (Chap. VIII.) On the defensive it is given a specified sector to cover with its fire. The unit is responsible that the enemy does not advance in that sector. The hostile troops most dangerous to the firers are those making the most progress in that sector.

As the combat develops it generally resolves itself into a line of separate fights, and small groups of the enemy under natural leaders work their way forward at different points of the line and become the rallying points upon which a strong line is built by the attackers. It is the sum of the efforts of these groups that make up the final strength in the assault, hence their initial efforts must be checked at once.

Individuals must be trained not to fire outside the assigned sector without orders.

If the fire of an organization is diverted to another sector, it should be shifted back to its own sector as soon as possible after the appearance of a target therein.

It is to be remembered that the men will, as a rule, fire only on that part of the enemy nearest them, as this will appear to them to be the source of greatest danger.

Large and vulnerable targets, that offer great returns for the expenditure of ammunition, should not be neglected. At the same time fire superiority over the entire line must be maintained.

Troops deployed and under fire can not change front; in case a false deployment has been made, other troops should be sent forward in the correct direction and the men already deployed pulled out and re-formed.

The correct way to meet an enfilade fire is with fresh troops.

In a meeting engagement, troops as they come successively on or into the line of battle take as their part of the target the enemy directly in front of them.

EXERCISES.

191. I.—**Object:** To train the men not to shift their fire to unauthorized targets, but to continue firing in the assigned sector and at the designated objective until ordered to change.

Method: The squad or platoon on the defensive as part of a general line watching a designated sector. Troops to the right and left, assumed or represented. The enemy represented by two details, each detail to consist of from four to six men concealed in the foreground.

One of the details representing the enemy at a signal appears in the designated sector at a range of about 600 yards. The defense opens fire (simulated firing). In a few seconds later the second detail appears at a signal at a much closer range, but outside the assigned sector. Some of the men will invariably shift their fire to the second target.

The exercise is made more realistic if the instructor will give the men a short talk before the exercise is started on the choice of targets, and mention, as an incidental point, that the men should not shift their fire to unauthorized targets without orders. Then quietly advise one or two men what is to happen, and that when the second target appears they are to call out, "**There they are; look out, etc.**"

THE DENSITY OF THE FIRING LINE.

192. Based upon the estimate of the situation, a commander must decide the number of men that he is to put in the firing line.

This decision determines the amount of fire that he will direct upon the enemy.

Manifestly, 50 men on a front of 100 yards can not develop as heavy a fire as can 100 men on the same front.

Extending the skirmishers to wide intervals keeps losses at a minimum, but such a line can not cause the enemy as much loss as can a heavy line.

Two conflicting elements here enter:

(1) The desire to avoid losses by the use of a firing line with the men at wide intervals.

(2) The desire to attain the greatest fire effect by putting the largest possible number of rifles in the firing line.

One hundred men on a 200-yard front can obtain the same fire effect on a given target as can the same number of men on half that front. But in battles there must be taken into consideration the question of fire effect per yard of front and the space necessary for deployment of other troops. In very small combats, patrols, and outposts, a line deployed at wide intervals is possible and at times may be preferable. The difficulty in controlling a line of this kind must always be taken into consideration. In large engagements tactical considerations and the lack of room usually demand a thick line.

Increasing the number of rifles in the firing line increases in direct proportion the vulnerable area of the line, but the percentage of losses will be lower in the thicker line. For instance, doubling the number of men in the line does not double the number of men hit, because the volume of fire on the enemy's line is double that possible with the weak line; consequently the accuracy of the enemy's fire is reduced.

The subject of the proper density of the firing line, while really pertaining to the study of maneuver tactics, is such as to justify an inquiry here into those conditions which must be considered before determining in a given case the density of the attacking lines. Each must, of course, be decided on its merits. All movements on the battle field have but one end in view—the development of the fire in a greater volume and more effectively directed than that of the opposing force—and, although the bayonet plays an important part, it is

superiority of fire that decides the conflict by permitting an advance to where the bayonet may be used.

Tacticians approach this subject from either one or the other of two quite different viewpoints. In one case, and unfortunately in the too common case, the mental attitude is "How best can I reduce the loss of life?" while the other and correct attitude is "How can I increase the effect of my fire?" Both questions must be answered before a satisfactory solution can be reached, but since they lead to opposing replies one must dominate and the other assume a secondary place. The first gets nowhere and can not lead to a success of any mag-

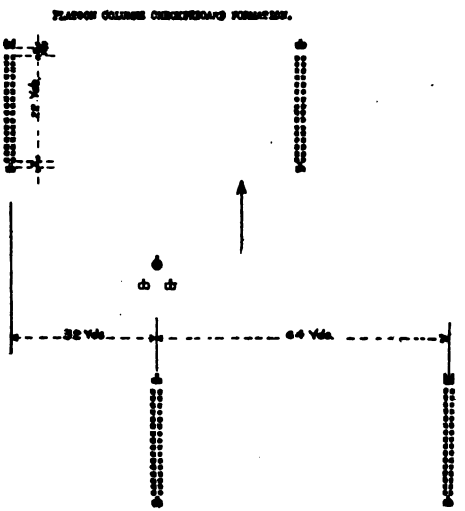


FIG. 44.—Platoon columns, checkerboard formation.

nitude; the second attains results. In the first the officer attempts to regulate the effect of the hostile fire, and in the second he seeks to control the effect of his own fire.

If small losses are to be the guiding principle, it is best that the army stay at home and suffer no losses at all.

193. The infantry advancing to the attack from the point where it first comes under artillery fire to its first firing position is concerned with only one question. "To reach that firing position with a minimum loss of life." This is true not only from humanitarian motives, but also because the point

where the rifle fire must begin is largely dependent upon the losses sustained. The fewer the losses the farther forward the line can advance without firing, and the farther it advances without firing the surer is fire supremacy gained when the line does begin the fire. Hence under artillery fire only the infantry may be formed in platoon columns, checkerboard formation (fig. 44), or the columns écheloned to the rear (fig. 45), or thin lines (fig. 46) (never in squad columns), thus offering to artillery the least favorable target. This advance is continued even into the first stages of the defenders' long-range infantry fire.

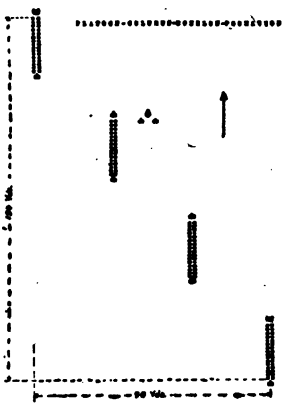


FIG. 45.—Platoon écheloned from left to rear

Platoon columns, being very vulnerable to the direct fire of infantry and machine guns, must deploy into thin lines or as skirmishers at wide intervals to pass over ground swept by the enemy's direct-aimed fire.

It must be clearly understood that there may be no necessity for all the columns to deploy at the same time. When advancing on a wide front one platoon may be compelled to pass over a dangerous piece of ground in a skirmish line. But the platoons to the right and left may still be in a ravine or behind a hill which hides them completely.

After having crossed dangerous ground the platoon reforms its column without halting and continues the advance.

Capt. E. J. Solano, in writing of the present war, says: "Small columns in what are known as 'artillery formations' should

never be adhered to when there is a possibility of their coming under close or medium range fire of infantry or machine guns. Troops have suffered severely from insufficient extension, and the adoption of rigid lines, and also from pushing forward in close formations without taking the proper military precautions. Loose, elastic formations, adapted to the ground, with men at 8 or 10 paces interval are the least vulnerable.

Several times it has been necessary to advance under unsubdued artillery fire. Small columns at 50 yards interval and 300 yards distance have been found to be the best method of avoiding casualties. The nineteenth brigade lying in the open in this

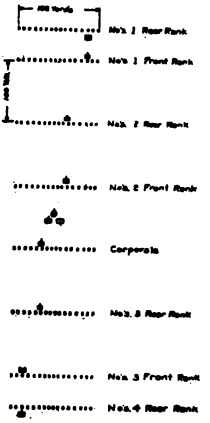


FIG. 46.—Advance in thin lines. 1. (Such numbers) forward; 2, March.

formation were shelled by two batteries for half an hour and had only 25 casualties." (Musketry.)

194. When, however, the point is reached beyond which the men will not advance without firing, the attacker begins to build up a firing line of sufficient density to produce an efficient fire. At this range, which should not be greater than 800–1,200 yards few hits can be expected.

Therefore to secure a sufficient number of hits the fire will then be increased in volume. A rapidity of fire of more than five shots per minute at this range reduces the number of hits in a given unit of time, unless the target be an exceptionally large and vulnerable one, hence there remains no other alternative than a firing line of at least one man per yard, which ex-

perience shows to be the space ordinarily needed by a man for freedom of movement in firing.

It is, of course, a serious mistake to make the firing line too thick, for thereby one increases losses with no compensating gain, but with a line as thick as may be with proper room for handling the rifle, supremacy of fire is not only attained sooner, but the whole attack is made in less time, the men are kept out in the rain of bullets for a shorter time and the spirit of the attack is not allowed to lag.

A thin firing line may be used when the situation is still in doubt—that is, in a reconnaissance.

FIG. 47.

In the Spanish-American War and in the Philippines thin lines were used successfully, but the inferiority of the Spanish and Filipino troops must be considered. These were proper cases for the use of thin lines.

195. Officers and noncommissioned officers should thoroughly appreciate the relation existing between the strength of the firing line and the resulting hits to be expected. The men should be taught the necessity for thick lines, but should be warned to avoid bunching in rushing and the accompanying crowding together so thickly that they can not use their rifles.

Figure 47 shows a line rushing, the men all bunched together. This makes an excellent target.

The men rushing bunched, as in figure 47, were halted, and figure 48 shows what happens—the men in a part of the line

are crowded so closely together that they can not use their rifles. Hence their vulnerability as a target has been increased by crowding together, and at the same time there is a loss of fire effect. European writers in the present war all warn against the evils of bunching in the advance and insist that, when rushing, individual men must be trained to advance in a straight line toward the enemy, not swerving to the right or left in search of cover.

The strength in rear, the supports and reserves, should be such that the firing line can be maintained at the proper density.

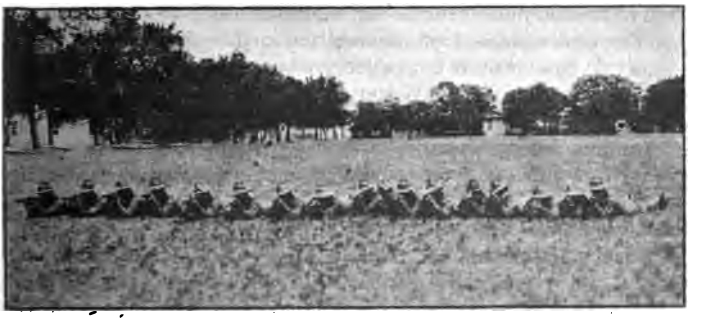


FIG. 48.

TIME OF OPENING FIRE.

196. The soldier's first impulse when fired upon is to return the fire. In other words, to shoot up his courage.

The men must be taught the futility of long-range fire, and they must be so trained that their leaders can get them to within an effective range before fire is opened.

It must be impressed upon all that the attacking line does not stop to open fire, but it only opens fire when stopped or until further progress can not be made without firing.

The weight of all military authority is to the effect that an attack in which the attacking line stops to open fire before having reached a range at which the fire will be effective (800 to 1,200 yards) never succeeds. Considerations of time, target, ammunition, and morale make it imperative that the attack withhold its fire and press forward to a first firing position close to the enemy.

Full advantage of the terrain is taken and the men are kept in small columns in order to prevent individuals dropping down and commencing to fire without orders.

It is to be remembered that troops advancing to the attack without cover will suffer losses. Men must be trained to expect these, but each and every one should have firmly imbued in his soul that to stop to commence firing before reaching a close range is to lose the fight. An enemy can not be shot out of his trenches. The bayonet wins the battle.

Fire, as a general rule, should rarely be opened by infantry in attack when satisfactory progress can be made without it. The leading troops, in particular, should save every possible round for the final struggle for superiority of fire at close range, as the replenishment of ammunition to the firing line at that time will be almost, if not entirely, impossible.

Fire properly controlled and directed is effective against large targets at very great ranges.

Infantry should not hesitate to seize opportunities for long-range fire against troops massed, such as reserves and other formed bodies, provided that the opening of fire does not prematurely disclose the position.

Long-range fire is permissible in pursuit on account of the moral effect of any fire under the circumstances.

In the defense, ranges are more easily determined, and the enemy usually presents a larger target. The defender may therefore open fire and expect results at longer ranges than the attacker, and particularly if the defenders intend a delaying action only.

If the enemy has powerful artillery it will often be best for the defending infantry to withhold its fire until the enemy offers a specially favorable target. Vigorous and well-directed bursts of fire are then employed. The troops should therefore be given as much artificial protection as time and means permit, and at an agreed signal expose themselves as much as necessary and open fire. (404, I. D. R.)

Long-range targets are primarily for artillery and machine guns.

The disadvantages of long-range fire are:

(1) Its effect is insignificant when compared with the amount of ammunition used.

(2) Ammunition is hard to replenish during the attack.

(3) The individual firer can hope to keep up his fire only for a certain length of time. His arm and eye get tired, the rifle

hot, and he does not take the trouble to aim or bring the piece to his shoulder.

(4) The enemy's morale is increased.

(5) The surprise effect of the fire is often lost.

(6) It often indicates the position of troops which might otherwise be unnoticed by the enemy.

The major usually indicates the point or time at which the fire fight is to open. (304, I. D. R.) He may do so in his order for deployment or he may follow the firing line close enough to do so at the proper time. If it is impracticable for him to do either, the senior line officer with the firing line in each battalion selects the time for opening fire. Conditions may require a company commander to open fire at some place other than that designated by the battalion commander. However, the provisions of the Drill Regulations should be followed whenever possible, and, as a rule, the battalion commander should designate the firing position. The firing line should, if possible, advance without firing to within 800 yards of the enemy's line. At this first firing position the attack seeks to gain fire superiority. Fire on the hostile main position should not be opened until all or nearly all the firing line can join the fire. The major, during the early stages of the attack, is in a better position to have a general grasp of the whole than is one of the captains. He is farther back from the firing line and is not influenced by losses that may occur in the advance to the first firing position.

In unexpected close encounters a great advantage accrues to the side which first opens rapid and accurate fire with the battle sight. (405, I. D. R.)

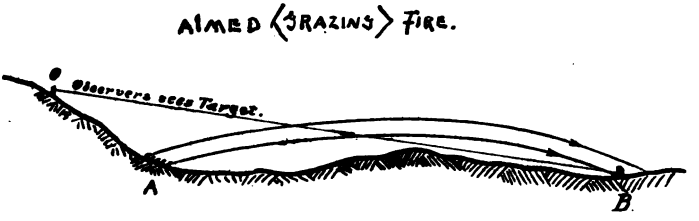
197. Fire of position—that is, fire of specially selected troops of machine guns occupying a flank of elevated position from which they can bring an effective fire upon the enemy's line to assist in covering the advance of their own firing line—may be used at rather long range.

This fire is usually very effective on account of the calmness of the firers, the unchanging range, the fact that these troops do not participate in the assault proper, the ease with which they are supplied with ammunition, and because they do not disclose their first line and are not within the effective zone of the enemy's fire.

The development of machine guns practically excludes the rifle from this class of fire.

KINDS OF FIRE.

198. Fire is classified, according to its application, as indirect, unaimed fire of position or covering, enfilade, concentrated, distributed, converging, mutual-supporting or covering fire.



C. Observer in such position that he can see the target and direct the fire against it.

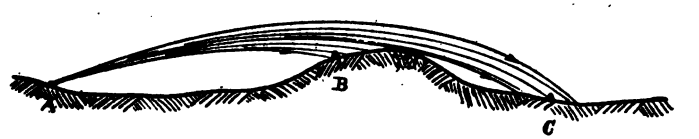
A Artillery

B The target.

FIG. 49.

Indirect fire (fig. 49) is the class of fire habitually used by Artillery. Its use by Infantry is most exceptional.

199. Troop leaders, to enable them to avoid the effect of unaimed or sweeping fire, must have a correct grasp of the angles



A Attacking line.

B Enemy's firing line

C Enemy's reserve.

FIG. 50.

of fall of rifle bullets at various ranges, appreciate the effect of slopes and sites, and understand the subject of the vulnerability of formations.

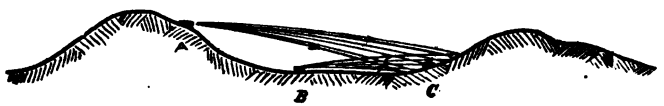
200. Fire of position, figure 51, see paragraph 197.

201. *Enfilade fire* (fig. 52).—This is the most effective class of fire. On July 31, 1904, Gen. Marston, of the Russian Army, was

in position on the heights at Pien Ling, Manchuria, with the Second Infantry Brigade, 8 field guns, 2 mountain guns, 2½ sotinas (each sotina about 150 men) of cavalry, and 1 company of engineers. Part of the force occupied a sunken road. The Japanese attacked the front early in the morning but could make no progress. Finally seven daring infantrymen of the Japanese Army worked their way around into a position from which they brought an enfilading fire on the Russian left. The fire of these seven men caused the Russian line to give way.

202. In figure 53 the line *A* has concentrated its fire on the machine gun at *B*. This class of fire is very effective against machine guns.

FIRE OF POSITION, or COVERING FIRE.



A Troops using fire of position or covering fire.

B Attacking troops

C Enemy.

FIG. 51.

203. Figure 54 illustrates perfect distribution (Chap. VIII).

204. Coverging fire (fig. 55) combines the effect of enfilade and concentrated fire and is very effective against columns, machine guns, etc.

205. Mutual supporting or covering fire (fig. 56) is for the purpose of keeping the entire enemy's line covered with fire in order to permit other parts of the attacking line to advance.

In figure 56 the company, consisting of four platoons, is covering the target by the overlapping method (par. 135) and attacking the line AB. The second platoon, by temporarily increasing its rate of fire, is making up for the loss of fire effect of the first platoon, which is rushing forward.

NOTE (par. 257, I. D. R.).—Troops are trained to change slightly the direction of fire so as not to endanger the flanks of advanced portions of the firing line.

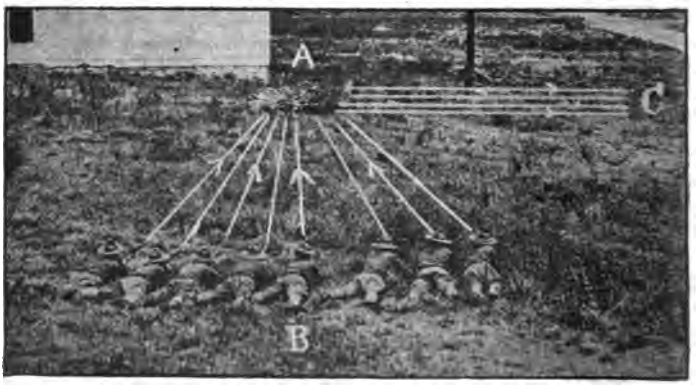
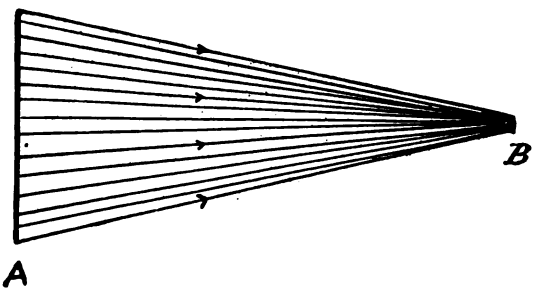


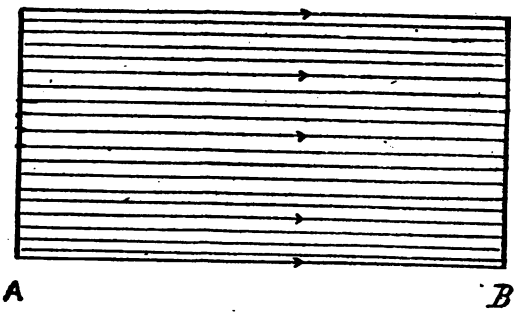
FIG. 52.
The line at *B* enfilades that at *A*.

CONCENTRATED FIRE.



A Firing line.
B Enemy machine gun.
FIG. 53.

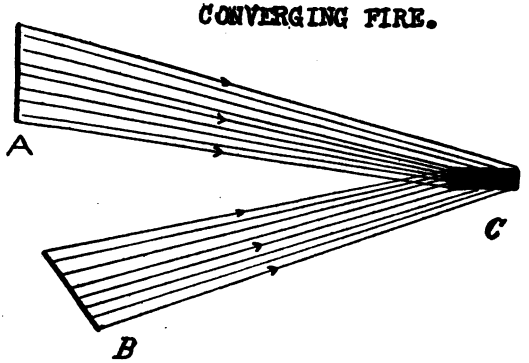
DISTRIBUTED FIRE.



A Attacking line.
B Enemy line.

FIG. 54.

CONVERGING FIRE.



A & B Two firing lines directing their fire on an infantry column at C.

FIG. 55.

It is also to be noted that fire of position is sometimes called covering fire.

206. Fire is also classified according to the manner of its delivery.

The Infantry Drill Regulations prescribe volley, at will, and clip fire.

Volley fire is the simultaneous discharge by a number of men of their rifles at a word of command.

Mutual supporting or covering fire.

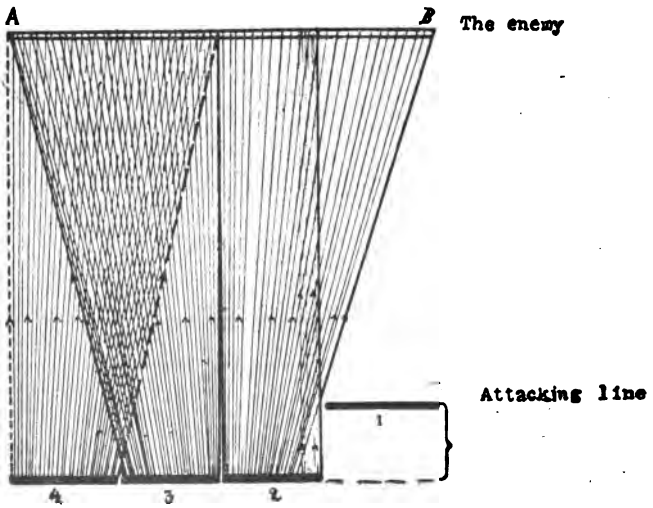


FIG. 56.

In the days of a slow-loading rifle of limited range, the importance of volley fire was due to the fact that it enabled the leader to develop the greatest volume of fire in tactically favorable moments, or, in other words, when large targets were visible for a short time only. The pause also permitted the powder smoke of the old black powder to clear away. Modern combat is conducted under different conditions.

Except for fire of position and in the determination of ranges, volley fire need not be considered.

Fire at will is that class of fire in which the marksman, having been given the range and the objective, sets his sight, opens fire at the command of the director or controller, and thereafter continues to fire independently.

This is the only class of fire that need be seriously considered; it implies that the men are thoroughly trained in fire discipline and control.

Clip fire is simply a means whereby the officer may control the amount of ammunition that he desires used at any particular firing point.

THE RATE AND VOLUME OF FIRE.

207. Other conditions being equal, the efficacy of fire depends upon the rate at which casualties are produced in the enemy's ranks. It is apparent, therefore, that the deciding factor is not the *percentage* of hits, but the *number* of hits obtained within a unit of time.

A great number of hits per minute is obtained by (1) increasing the individual rate of accurate fire and (2) directing the fire of more rifles at the particular objective in question.

208. There is necessarily a limit to rapidity of fire which, if exceeded, will result in some loss of accuracy. This rate of effective fire depends upon a number of factors:

(1) It will be faster for trained than for untrained troops.
(2) It will be faster at a large than a small target.
(3) It will be faster at a target which stands out in bold relief than at one which is vague in outline and whose color blends with a neutral background.
(4) The physical condition and the morale of the untrained troops has a marked influence on the rapidity of effective fire.
(5) The aiming position also has its effect—one can fire faster from an easy position than from a cramped one.
(6) It will be faster at short than at long range.
(7) It will be faster at the beginning of an action than after firing has continued for some time.

209. There is some variety of opinion as to the rates of fire which are consistent with accuracy, and it is obvious that in proposing a standard of performance no more can be done than to present an approximation to which there must be some exceptions. The standard rates of fire proposed below are based upon experience and observation at the Musketry School (Monterey). When firing a single clip the rate is obviously faster than when two or more clips are fired.

	Range.
10 per minute	200
	300
	400
7.5 per minute	500
	600
	700
5 per minute	800
	900
	1,000

(At greater ranges 3 per minute, 209, S. A. F. M.)

This rate includes the time required for recharging the magazine which is taken to be 10 seconds. Should the rate of fire at any range fall very much below the rate given it may be said that a proper use has not been made of the time element, and should the rate be very much in excess of the standard given, it may be concluded that there has been some loss of accuracy. The rates given should not exclude higher rates of fire, in the case of large and very conspicuous targets, such as dense skirmish lines, bodies of cavalry, or batteries of artillery.

An exceptionally low rate does not improve the accuracy of the fire, and on the other hand the rate of 10 shots per minute can not be exceeded by the average soldier without a loss in accuracy. A high rate of fire may easily degenerate into unaimed fire.

210. The following table shows the result of experimental firing by a squad of average marksmen at the School of Musketry:

[Targets, 8 E, spaced at 1 yard center to center. Range, 500 yards.]

Rate of fire per minute.	Number rounds fired.	Hits.	Hits per minute.	Targets hit.	Per cent of accuracy (hits).	Per cent of distribution.
15	80	23	11½	6	14.37	71
10	160	44	22	8	27.75	100
5	80	31	15½	8	19.44	100
10	80	19	19	8	23.75	100
15½	124	21	21	8	16.94	100

From this table it is apparent that there is a correct rate of fire for the different ranges and for the different degrees of training of the men. Manifestly if two forces are firing against

each other at this range and one maintains a fire of 10 shots per man per minute and the other fires at the rate of 5 shots per man per minute, the first should have fire superiority.

It is to be remembered that rapid fire is primarily rapid manipulation of the piece, i. e., reloading and aiming.

211. The rate of fire is dependent to a great extent on the size and visibility of the target. The larger the target and the more plainly it stands out the quicker and easier can the soldier catch his aim. On the other hand, if the target is small and indistinct it takes more time to find the aiming point after each discharge of the rifle.

Short bursts of rapid fire, especially if they are in the nature of surprise fire, should and will be very effective.

There are two forms of rapid fire: That which might be called the ordinary rate, as given in the Standard for Field Firing, and quoted above, and then a very high rate of fire maintained for a few minutes, which the English call the mad minute. The latter is used against favorable targets appearing during the fight and which demand a veritable whirlwind of fire (such as repulsing a cavalry charge, the moment before charging, etc.). This kind of fire can, however, be kept up for only a short time, not exceeding two to four minutes, on account of the enormous expenditure of ammunition, the fatigue of the men, and the excitement which a prolonged and continuous rapid fire produces on the men (the physiological effect). Col. von Scherf says:

"The physiological influence of a rapid fire on the nervous system of the combatants is such that at the end of a very short time, which can not reasonably last more than five minutes, the troops on the offensive will either dash forward or retire."

The expenditure of ammunition during these minutes of extreme rapid fire will be enormous, but such targets and such opportunities to inflict a heavy loss upon the enemy fully justify the expenditure.

The rate of fire attained in these bursts without loss of effect depends directly upon the peace training of the troops; with men properly trained it may be as high as 15 to 20 shots a minute.

With untrained or partially trained troops it is, of course, the height of folly to expect them to reach this standard; their dispersion increases to such dimensions as to be of absolutely no value.

212. The range influences the rapidity of fire, as the greater the distance the more is time necessary in aiming, the position of the firer becomes more and more strained, and the target is more difficult to see and to hit.

Pauses in the fire in the past were necessary to let the smoke clear away; at present they are of advantage in giving the men a breathing spell, rest eyes and nerves, enable ammunition to be distributed, and allow organizations to re-form.

During such pauses good cover, good observation of the enemy, and instant readiness to resume the fire are essential.

The officer or noncommissioned officer, in determining the rate of fire, must consider the replenishment of ammunition. With 220 rounds on the person, the man will be able to maintain a 10-round rate for only 22 minutes.

All of the foregoing factors must be taken into consideration, and then, if the mission is such that it demands a high rate, even with its tiring effect upon the men and the expenditure of ammunition, it should be ordered without hesitation.

EXERCISES.

214. I.—**Object:** To train men to fire at the ordered rate.

Method: A squad or platoon in the prone position. The instructor first explains the necessity and the reason for the men maintaining an ordered rate of fire. He then, by counting 1, 2, 3, 4, 5, etc., in a minute indicates the different rates after which the men are given a target and a rate of fire. The men then simulate firing, time being kept by an assistant. This is repeated until the men can fire at any ordered rate.

215. II.—**Object:** To train the men to load rapidly.

Method: Loading from belt, pockets fastened, with a clip of dummy cartridges, in the belt. All positions standing, kneeling, sitting, and prone. The squad or platoon in line, instructor commands load. Maximum time limit of 10 seconds each in best five out of seven consecutive trials.

It should be impressed upon the soldier that rapid fire is principally rapid loading.

216. III.—**Object:** To train men to set sights quickly and accurately.

Method: The squad is formed in single rank, arms at the order. The instructor commands "Range ———." All men then set their sights and come to the order. All sights should be correctly set in 10 seconds.

THE DISTANCE BETWEEN ECHELONS.

217. The distance between echelons depends upon (*a*) the object to be attained, (*b*) the nature of the action, and (*c*) the terrain.

In an attack the distances between echelons should be decreased in the course of the action. Leaders of all grades should be animated by but one desire, that of being in front in order to participate in the gaining of the victory. The duration of the crisis of the action is usually brief, and in a very few rapidly passing moments the leader must decide what to do with the troops remaining available.

When an immediate decision is not sought, it is advisable to increase distances in order to keep the echelons held in rear from coming under fire. In any case, the distance between supports and the firing line should be less than the distance between the firing line and the enemy.

Supports should be close enough to the firing line (in an attack) to prevent, by timely interference, a retrograde movement of the latter.

All commanders must be ready with supports to stop any movement to the rear.

While the lines in rear can not be kept entirely out of hostile fire during an attack, care must nevertheless be taken that they be held far enough back to prevent their feeling the full effect of the fire directed at the firing line.

218. Supports held too close to the firing line in open country will cease to exist as such. The boldest join the firing line of their own accord and the timid seek cover.

The supports on the defensive are usually placed a short distance immediately in rear of, or within the firing line (intrenched) at the points where they are to be employed. On account of the difficulty of bringing supports up for the purpose of repulsing an assault they must be held so near the line that they can readily reinforce it under all emergencies.

This may compel distances as small as 50 yards, notwithstanding the consequences of the cover trenches coming within the dispersion area of artillery directed at the fire trenches. The prompt reinforcement of the firing line at the critical moment is a delicate matter. The enemy's artillery fire, having supported his infantry at the decisive range, will next be directed to cover the rear of the position. It is at this moment

that the supports attempt to reinforce the fire trench. If, therefore, the supports are placed too far to the rear they may not only fail to arrive in time, but in order to come up at all must cross ground likely to be swept by artillery fire.

219. Reserves, both sector and general, must be so located that they can reach all equally important points of the firing line with equal facility.

The reserves should generally be placed far enough to the rear to escape the effect of "overs" from hostile artillery; that is, not nearer than 300 yards.

For a discussion as to the position of supports on rising and falling slopes and on level ground, see paragraph 44.

OBSERVATION OF FIRE.

220. The actions of the enemy are usually the only reliable indication of the location of the sheaf of fire against him.

It is especially difficult to judge of the distribution of bullets from their strike in front of and in rear of the target. Suggestions from the subordinate leaders, whose view of the target is generally restricted, are often more confusing than valuable.

If the assailant finds that the defender's fire is steady and continuous, he may assume that his own fire is ineffective. If the defender sees the front line of the assailant advancing with confidence but the supports in confusion, he may take it that his rear sight elevation is too high; when the advance is hesitating but continuous, that it is too low; if the enemy halts to fire and gains ground by rushes, that it is correct.

If one observes that the hostile bullets are going wild, some striking far short, others very high and very ineffective, he has fire superiority, and it is time to gain distance to the front. On the other hand, although he may be suffering no losses, if he sees that the enemy's bullets, well massed, are striking, say, 50 yards in his front, he has no fire superiority; the enemy has simply underestimated the range, and his, the observer's, advance will bring him into the center of the beaten zone. But this is the opportunity to gain fire superiority. The men are suffering little or no loss; they should be less affected by the enemy's fire and should do better work. If this opportunity is well used, fire superiority should soon be wrested from the enemy.

221. Observation to the front must be continuous and uninterrupted both for the effect of the fire upon the enemy and for his movements. The flanks must also be watched; this is provided for by flank or combat patrols.

The battalion staff assist the major in observation and the buglers assist the captains; the guides assist the platoon leaders.

Not the least important is the observation of the adjoining troops. Their action may show the effect of the fire upon the enemy. If they are advancing, the fire is apparently so effective that the enemy can not divert his fire to them. Their continued advance, however, will draw more fire to them. The advance of one fraction of the line takes the pressure off the adjoining ones.

Good field glasses are indispensable in observing the effect of fire and in locating an enemy whose position is not exactly known.

On the defensive, when troops are in trenches and not firing, all the men are not kept watching to the front, but one or two men in each platoon are designated to watch. The other men rest.

Any man who sees anything unusual should at once call out, thereby attracting his squad or platoon leader's attention to it. *This is a rule.*

CHAPTER XIV.

VULNERABILITY OF FORMATIONS.

222. The vulnerability of a formation is its likelihood of being struck by hostile fire. That formation which by computation is shown to receive the greatest number of hits from a given number of hostile shots is said to be the most vulnerable. Rifle fire only is considered.

The relative vulnerability of several formations is, therefore, determined by computing the number of hits expected, under identical conditions, on each of the several formations and then comparing these expected results.

A brief synopsis of vulnerability is here given in order that the student may have at a glance the deductions that have been made regarding the subject.

223. In the study of this subject two conflicting interests are to be considered: (1) The avoidance of losses; (2) a heavy firing line.

The first demands very wide intervals between individuals in the skirmish line; the second a very heavy line—only enough intervals between skirmishers to permit of the free use of the rifle and bayonet. (Par. 192.)

Troops may come under aimed and unaimed fire.

Aimed fire is fire that is directed at the particular body whose vulnerability is being discussed.

Unaimed fire is that fire in which some of the shots aimed at and intended for some other objective fall into the area occupied by the body whose vulnerability is being considered.

There is a slight difference in the method of calculating the vulnerability of formations under aimed and unaimed fire.

The vertical dispersion of average marksmen between 500 and 1,000 yards is about 1 foot greater than the lateral dispersion, hence the height of the target under aimed fire is a greater factor than is the lateral width of the target. In other words, a long, low target will not get as many hits as a target, say, of half the length but twice as high.

Under unaimed fire the number of hits to be expected is absolutely dependent upon the vertical square surface presented to the enemy's fire, because the fire is considered as evenly distributed over the front covered by the line receiving the fire.

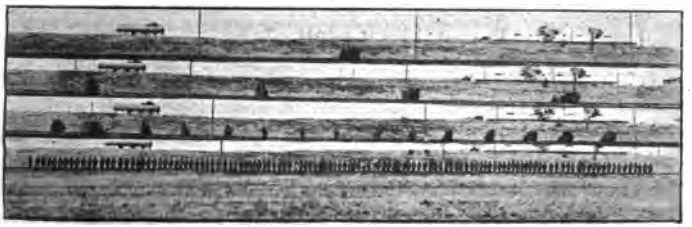


FIG. 57.

224. From top to bottom figure 57 shows the relative size of the targets offered by a company of 15 squads in—

Column of squads,
Platoon columns,
Squad columns,
A skirmish line.

225. An organization may come under fire in any of the following formations:

(1) Company front,
(2) Line of platoons,
(3) Squad columns,
(4) Platoon columns,
(5) Column of squads,
(6) Line of skirmishers,
(7) Column of platoons.

226. It is thus apparent that, in general, the line is least vulnerable under aimed fire, and the line of small columns least vulnerable under unaimed fire.

CHAPTER XV.

NIGHT FIRING.

228. "The invisibility afforded by darkness neutralizes the power of the rifle to a great extent by making it impossible to employ the ordinary means of fire adjustment. In night attack the purpose of the offensive is to gain rapidly and quickly a position where the issue may be decided in a hand-to-hand encounter, or a position from which the superiority of fire may be gained at daylight."

The offensive should not use fire action at night. It can not be too strongly impressed upon all ranks that to fire during a night attack, on the offensive, is not only useless but is absolutely criminal.

The bayonet is the weapon that decides the issue. Hence it should be fixed and the chamber and magazine, if possible, should be empty.

It is exceedingly unlikely that the enemy will be completely surprised, but every second of delay between the discovery of the attacking force and the delivery of the assault is of priceless value to the defense; it must, therefore, be understood by all ranks that when the enemy opens fire the only course open to them is to press on to the assault and cross bayonets with the enemy.

Night attacks are only possible with troops highly trained.

229. Many men up to the time of their enlistment have passed their lives entirely in big cities or large towns and have rarely been beyond the range of street lights. Such men, when first taken out in the dark, are helpless; they start at every shadow, stumble on level ground, make a lot of noise, and are generally in such a state of nervous excitement that they are hardly responsible for their actions. Yet these men, by a short course of careful training and individual instruction, can soon learn to work together with confidence in the darkest night

If in daylight the moral is to the physical as three is to one, there can be no doubt but that at night the proportion is many times greater.

230. A body of troops on the defensive may arrange to sweep open ground, an approach, or a bridge which may be used by the enemy by having their rifles in rests, so that they sweep the ground without any aiming by the soldier. These rests are put in place in daylight.

The rifle should not be fastened in the rest, as that would delay taking it out for hand-to-hand fighting.

Illuminated aiming marks giving a horizontal line of sight may also be used, and the flashes from the enemy's rifles may be used as aiming marks. The firing should be at very short ranges only.

The best assistance in firing at night is to illuminate the foreground by searchlights, but this is usually impossible except in trench warfare.

Bonfires may be lighted. These must be prepared in advance and lighted when the lookout gives the alarm.

Star shell rockets were used by the Japanese in 1904, and in the present war all sorts of appliances—flares, searchlights, and star rockets—have been used with good effect.

231. It should be reiterated that every infantryman must be imbued with the idea that at night the only weapon he can trust is the bayonet, and that the more promptly he uses it the better his chances of success.

In the dark every advantage is on the side that takes the initiative; numbers are of little account, for a resolute bayonet charge delivered by even a single picket may, if it comes unexpectedly, demoralize and throw into disorder a strong attacking column.

Sentries should be taught to allow persons to approach fairly close to them at night before challenging and not to fire except to give the alarm, unless they can clearly distinguish and be fairly certain of hitting. At the commencement of a campaign sentries are continually firing at nothing, but as they gain experience shots at night become rare; it is only a question of training, and this should be given during peace time.

It is reported that there is a rule in the French Army, serving in Algeria, that any sentry who fires at night must produce a corpse or, at any rate, be able to show by blood marks that he

has hit the person fired at; failing in this the sentry is dealt with for giving a false alarm.

A small force on the defensive should, if it gets warning of the advance against it at night, wait until the enemy gets within 30 yards; or on dark nights less, then every rifle should be fired once, followed immediately with a bayonet charge.

For night firing without rests the men must be taught to hold the rifle horizontally. This may be taught by having the soldier close his eyes and bring his rifle to the position of aim, attempting to hold it horizontally. Then have him open his eyes and look at the position in which he is holding his rifle.

This exercise may be continued by squad as in the position and aiming drills.

When the men become fairly proficient in holding the rifle horizontally they should fire at the gallery target with eyes closed.

CHAPTER XVI.

AMMUNITION SUPPLY.

232. The soldier carries 100 rounds in his belt and there is 120 rounds for each man in the combat wagons.

The battalion is the tactical unit, and the major, as its commander, controls the supports, hence he also controls the delivery and distribution of ammunition on the battle field to the firing line.

When the battalion is deployed on the major's initiative, he indicates whether extra ammunition shall be issued; when deployed pursuant to orders from higher authority, he causes the issue of the extra ammunition unless specifically ordered not to do so.

This accounts for the 120 rounds in the combat-wagon.

233. In rendering a decision as to the issue of this extra ammunition from the combat wagon a commander (the major or higher commander) must consider:

(1) How long the fight will probably last. A short advance or rear-guard action might not require the issue of extra ammunition.

(2) How much ammunition will be used, considering rates of fire, etc.

(3) The nature of the terrain, whether or not it will permit of communication during the action. Thus it will be easier to deliver ammunition to the firing line over ground broken by ravines, gullies, etc., than it will be over level ground.

(4) The extra load for the soldier; his advance will be slower and more fatiguing carrying extra ammunition than without it.

234. Ammunition is supplied during the action by collecting that of the dead and wounded and by sending it forward by reinforcements, supports, and special squads detailed for that purpose.

Full advantage should be taken of every lull in the action, of cover, and other favorable conditions to distribute ammunition.

The ammunition of the dead and wounded is best collected by the supports as they move forward to join the firing line.

Men wounded not severely enough to prevent movement on their part should pass their ammunition to the men on their right and left.

Reinforcements going forward should always carry ammunition for the men in the firing line. It is to be remembered, however, that these men are carrying 220 rounds each of their own ammunition. Hence about two additional bandoleers each will be almost the limit for them.

Special squads may be sent forward with ammunition.

All men carrying ammunition to the firing line first deliver the ammunition, then join the line and take part in the firing.

Men are not sent back from the firing line for ammunition.

235. There are two methods of distributing ammunition brought forward to the firing line:

(1) The men that bring the ammunition forward fall into the firing line and pass bandoleers to the men on the right and left of them. The men already in the line help themselves from the bandoleers and pass them on or each man keeps a bandoleer.

(2) The ammunition carriers halt in rear of the firing line and under the direction of the platoon leaders and platoon guides roll along, keeping close to the ground, throwing the ammunition to the men on the firing line.

There is very little difference as to the efficiency of either method, providing the men are properly trained. The men must be so trained that there will be no decrease in the rate of fire during the distribution.

236. Men detailed to carry ammunition should, before starting forward, be deployed on a front equal to that of the line to which they are carrying ammunition, thus insuring uniform distribution.

EXERCISES.

I.—**Object:** To train the battalion in the supply and distribution of ammunition to the firing line.

Method: Assume an attack. One or two companies are designated as the firing line, the other companies as the support.

The firing line deploys and simulates firing. The support carrying empty bandoleers to represent the extra ammunition is sent in as reinforcement, part into the line and part on the flank. These bandoleers are distributed. All communication is by signal.

This exercise may be varied in many ways.

One variation. Cause the firing line to make its attack, certain designated men drop out representing wounded and dead men; their ammunition is collected and distributed.

237. The distribution of extra ammunition from the combat wagons is very simple. One method is to form the companies in double column, one column on each side of the road. The combat wagons drive between the columns and sufficient full boxes are thrown off for each company. This ammunition is distributed to the men of the company under the direction of one of the lieutenants (the captain probably receiving orders from the major at this time). As the wagon approaches a company the senior lieutenant meets it and calls out the number of boxes required for his company. One box (1,200 rounds) for 10 men.

All officers should know at all times the number of men present in ranks in their company; hence a simple division of the number of men by 10 gives the number of boxes required.

The distribution to a war strength battalion has been made in this manner in four minutes.

Extra ammunition is not issued to officers, to the first sergeant, or the musicians. These men have other more important duties to perform that make heavy demands upon their powers of endurance, and they should not be unnecessarily weighted down.

On the defense extra ammunition is stored in the trenches in convenient locations. Usually boxes are placed at intervals in recesses dug in the front wall of the trench under the parapet.

CHAPTER XVII.

MUSKETRY IN TRENCH WARFARE.

238. Nothing in the present war (1917) has affected the general principles of war as known and accepted by military men. Many of the so-called lessons of the war are as old as the hills.

The situation of two armies facing each other in long entrenched lines is that of siege warfare.

The same methods of fighting (modified by the employment of the increased power of the more modern weapons, and some of the weapons of the ancients, war clubs, etc.) are employed to-day as they were in the Crimea and at Port Arthur, only on a scale so vast as to be almost incomprehensible to the average mind.

The world's inventive and creative genius has been taxed to the utmost to develop ways and means of using and combatting gas attacks, grenades and bombs, snipers, and the machine gun, but the rôle of musketry (the use of the rifle and its bayonet) has not changed.

All authorities insist that intelligent fire direction, strict fire control, and a fire discipline founded upon careful instruction and implicit obedience to orders is more essential to success than it has ever been before.

239. The following special precautions for the care of rifles in the trenches have been found necessary:

(1) Rifles must be kept clean and well oiled, and it has been found necessary to make an inspection daily, or even oftener. Particular care must be taken to see that the chamber is scrupulously clean. If it is permitted to become dirty, great difficulty in extraction is likely to be experienced. It has also been found that cartridges get rusted into their clips, and that they should be moved at least weekly. The bolt and magazine must be tested daily to make sure that they are working freely. Many accidents will be avoided if men are never allowed to keep a cartridge in the chamber.

(2) A large number of cases have occurred of rifles becoming unserviceable from the following causes:

(*a*) Mud in the lock, owing to the rifle being rested on a wet parapet or dropped on wet ground. The remedy for this is to cover the bolt with a cloth wrapper or an old sock whenever the rifle is not in use and to place canvas on the parapet. The protecting material can be pulled back when it is required to use the rifle.

(*b*) Muddy ammunition, resulting in mud in the chamber. The remedy for this is to prohibit ammunition being put on the ground and to provide boxes or tins in which to place the ammunition. It is a good plan to rub the ammunition over with an oily rag.

(*c*) Mud in the muzzle, owing to rifle being pushed into the sides of the trenches. The only remedy is to see that rifles are clear before firing.

(*d*) Sticking of cartridges, owing to dirt in the chamber or magazine. If the chamber is not kept free from dirt, the cartridge case may jam and extraction become difficult. Similarly the magazine must be kept clean and oiled, otherwise the follower will not work freely.

(*e*) Rust in the lock and insufficient oiling.

It is well to remember that trench warfare can not last forever. The time will come when one side must make a huge effort to blow a hole in the other line. The attack will then take the form of one of great depth and will be strongly supported by artillery. No attempt will be made to build up firing lines. It will be a series of assaults by line after line. One must therefore be prepared to dash forward across the enemy's trenches, and when he is "on the run" keep him at it.

EXERCISES.

240. I.—Object: To teach the attack in trench warfare.

Method: In company training the captain may assume that his command has reached the fire trenches, which are as yet too far from the enemy's defenses to enable the final assault to be made from them. The company should construct two lines of trenches a hundred yards or so apart and facing toward each other. It will occupy one of these lines and sap approach trenches, branching out into parallels, toward the other, until the last parallel is only about 40 yards from it. This last parallel must be extra deep and strong. Head cover should be provided for it by sandbags, etc., overhead cover and wire netting raised to keep out bombs, blinded loopholes made, and

periscopes used to observe the supposed hostile trench. The men can be trained to hurl dummy bombs—tin cans filled with earth will do—into the enemy's defenses. When the actual assault is to be made, the last parallel should be crowded with as many men as it will hold; while the rest of the company is massed in the approach and original fire trenches. The watches of all the officers and platoon leaders should be set to correspond, and the order given that at a fixed time the firing is to cease and the assault made. Bayonets will be fixed and rapid fire opened. The artillery is supposed to be shelling the enemy's trench and wire entanglements. When the watches show the given minute the rifle fire ceases, the signal is given, and the whole company should climb out of the trenches and dash at top speed for the hostile trench. Once in it, everyone should go to work to turn its defenses round to face in the opposite direction. The sandbags and earth of its parapet must be thrown to the other side and piled up for protection. Empty sandbags should have been brought up by some of the men and now must be hurriedly filled and placed in position. Wire entanglements will be put up on the enemy's side of the captured trench, communication trenches dug back to the last parallel, ammunition and water brought up and stored, and all preparations made against counter attack.

CHAPTER XVIII.

THE SOLUTION OF FIRE PROBLEMS.

241. The troop leader acquires facility in the solution of fire problems by means of:

(*a*) Map problems.
(*b*) Terrain exercises.
(*c*) Preliminary exercises without ball ammunition.
(*d*) Problems with ball ammunition.

THE SOLUTION.

242. The solution of fire problems under assumed battle conditions requires a trained military mind, a knowledge of minor tactics, and a proficiency in musketry.

243. Estimate of the situation.—"An estimate of the situation involves a careful consideration, from the commander's viewpoint, of all the circumstances affecting the particular problem. In making this estimate he considers his mission as set forth in the orders or instructions under which he is acting, or as deduced by him from his knowledge of the situation, all available information of the enemy (strength, position, movements, probable intentions, etc.), conditions affecting his own command (strength, position, supporting troops, etc.), and the terrain in so far as it affects the particular military situation. He then compares the various plans of action open to him and decides upon the one that will best enable him to accomplish his mission." (Par. 89, F. S. R.)

244. Details of the fire estimate and order.

(*a*) THE FIRE ESTIMATE.

LOCATION, STRENGTH, AND INTENTION OF THE ENEMY.

245. Observation of targets.—The target and adjacent foreground should be given as thorough a study prior to opening fire as the time element and accomplishment of the mission will

permit, and it should be kept under constant observation during the entire action. All available field glasses should constantly sweep the front for observation of fire effect and to observe the enemy's change of position so that the leader will be ready to meet the enemy's detachments with fire from whatever quarter of the foreground they may appear.

246. Determination of ranges.—Before a decision can be rendered as to the method of adjustment to be employed (sight setting to be ordered, or the use of battle or leaf sight, or the employment of combined sights), consideration must be given to the method for obtaining the range or ranges, whether they be obtained by estimation by the eye, taken from a map, determined from an instrument or by ranging fire, or actually measured.

247. Relative importance of targets.—The estimate in this connection embodies two factors—the selection of the enemy targets that should be fired upon and the determination of the size of the units that will be ordered to fire on the selected targets.

248. Strength of firing line.—The number of rifles to be placed in the firing line must be sufficient to accomplish the mission. The determination of this strength must be the result of sound judgment exercised by the leader on the ground after a careful analysis of the mission and the means to be employed to accomplish it.

249. Location of fire positions.—The nature of the problem and the character of the terrain are the governing features in selecting fire positions. In defensive, outpost, or rear guard actions it is evident that great attention can be given not only to the selection of main and auxiliary fire positions, but to the consideration of advance positions for firing, and to the preparation of carefully chosen positions in rear of the main one. In the attack it may or may not be possible to select more than one firing position at the commencement of the fire fight. However, if it is practicable, it should be done.

250. Classes of firing.—The character of fire (collective or individual) and one of the various *classes* must be selected. The object to be attained will determine the use of volleys, fire at will, or clip fire. The visibility factor of the target may require indirect fire by use of an auxiliary aiming point, the uncertainty of the correctness of the range may demand ranging fire (individual, collective, and selected shots), etc.

251. Rate of fire.—The rate of fire depends upon the purpose of the action, the character of the target, and the available ammunition. The rate is affected by many factors, as training, range, size and visibility of target, position of firer, degree of surrounding excitement, etc.

252. Time of opening fire.—The time of opening fire is a factor of prime importance and may or may not be left to the discretion of the troop leader with which the problem deals. In any case, fire should not be opened until the director's fire estimate has determined upon the target, sight setting, class and rate of fire, and under no circumstances until the troops are ready to fire.

253. Formations in advancing under fire.—The best is the one that will best aid in gaining fire superiority and defeating the enemy with the least loss of men, time, and control.

254. Ammunition supply.—This detail of the estimate for company and troop officers is usually simply a consideration and an appreciation of the amount issued to the individual and how it can best be utilized in fulfilling the assigned mission.

For field officers it embodies the question of maintaining the supply and that of issue to troops.

(*b*) The Fire Order.

255. Announcement of the sight setting.—This may or may not coincide with the range estimate.

256. Designation of targets (Chap. V).—It is necessary here to impress upon one that the degree of the target's visibility determines the extent of definition necessary. Having this in mind, it is seen that the two extremes will be when the target is so obvious that no description whatever is required, and when it is so indistinct that one may be taxed to use a reference point and a combination of the two clocks and finger systems. The goal to be reached is an unmistakable designation expressed in the simplest and most direct manner in terms common to all.

ASSIGNMENT OF TROOPS TO TARGETS.

For the details of the systems used in the assignment of targets see Chapter VIII.

257. Directions as to occupation of fire positions.—These directions may not be necessary at all, or they may be very simple and covered in the order with the statement that the unit

will occupy "this position" with its right at "that point," or several positions may be designated for the various units to occupy in the opening fire fight against their particular assigned target. In addition to the position from which the fire fight is commenced, the order may announce a second fire position in the foreground that will be occupied in the advance. In defensive rear-guard and outpost actions it is quite evident that directions may be given for the occupation of several fire positions. There are times when these directions will be unnecessary, and there are occasions when such directions will be so clearly related to the firing that they will logically form part of the fire order.

258. Rate of fire.—The rate of fire may or may not be announced in the order. With well-trained troops the rates given in S. A. F. M., paragraph 209, would probably be employed without caution. However, as the rate of fire is so directly related to the vulnerable area of the target as well as to the range, it may be better to announce the rate desired in order to insure that the proper volume of fire is attained within the required time. The rate is increased or decreased by the commands "Faster" and "Slower."

259. Class of fire.—The selection of the kind of fire should result from the estimate and be announced in the order as "Fire at will" or "Clip fire."

260. Time of opening fire.—Ordinarily this would be confined to the estimate and no expression given to it in the order. However, so diversified are the factors in a fire order that some such time announcement as "Open fire when you are ready," etc., may be pertinent.

261. Position of leader during firing.—The company commander or commander of a small firing line will ordinarily be opposite the center of the rear of the line he is directing or upon that flank which offers the best opportunity for control of the line, observation of the enemy targets, and the fire effect. His position must be such that control is direct or where his will is easily and promptly transmitted. He must be in a position to control the ammunition supply. His position must not be fixed, but it must be known to all of his subordinates. A leader, who has decided to take position on the flank of his deployed line, to observe better the fire fight, and who feels that his subordinates should be informed as to his location, as communication might thus better be facilitated, should include his post in the fire order.

Until facility is obtained in the solution of fire problems, the controlling factors should be taken up in some such orderly manner as shown in the foregoing. It is almost certain that a decision reached after consideration of the factors noted will be of more value and more nearly correct than if based simply on mental impressions.

There will be few occasions in which all of the factors enumerated above will have to be thought out in the estimate and announced in the fire orders. In fact, the simplicity of most problems, particularly those conducted on "A" ranges will make it unnecessary to give any consideration to many of them. Again, it must be remembered that at the moment when the fire orders must be issued many of the factors embraced in the estimate will have been considered, some of them in an involuntary manner. On some occasions the fire order may be as simple as "Fire at will."

262. An example of a map problem and a possible solution. (See Chap. XXI for methods in the construction of fire problems.)

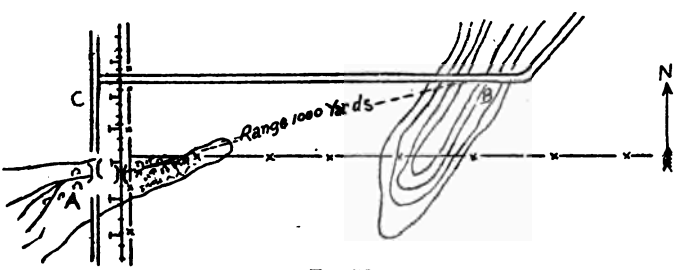


FIG. 58.

Capt. X's company (eight squads) has left the main body on a special mission, "To march south to reconnoiter and to protect bridges at A." (Fig. 58.)

On arrival at B the point signals, "Halt. Enemy in sight in force." Capt. X directs rapid assembling near B and joins the second lieutenant, who is now with the point.

The second lieutenant presents Capt. X with the results of his observation, as follows: About 50 led horses in south fringe of woods just east of railroad bridge, about 10 mounted men halted about 300 yards northeast of bridges tearing out wire fence, about 35 men dismounted moving from led horses toward rail-

road bridge, and about 15 mounted men at C moving north along road.

Requirements: (1) The fire estimate; (2) the fire orders.

A SOLUTION.

263. The fire estimate.—The captain, with his glasses, studies the front, verifies the targets pointed out, calls the lieutenant's attention to the telegraph poles and to the wire fence and directs him to obtain range with his musketry rule and to remain in observation of the target. The captain hastily looks over the ground for fire positions. On arrival of the company the platoon leaders and range estimators are assembled and targets pointed out with direction to estimate ranges. The captain in the meantime is weighing the relative importance of the targets. He determines their target value as follows: (1) The men moving toward bridges, the captain's mission being to protect the bridges and the appearance being that these dismounted men are on a mission to destroy them. The mounted men north and northeast evidently have missions as covering patrols. (2) The led horses. Good target and opportunity for large number of hits. If horses are routed, the effectiveness of the troop as a mounted organization has been destroyed, and besides the moral effect of such rout would probably materially impair the troopers dismounted action. (3) The detachment north of bridge. Unless they are fired upon they may continue on their mission. It seems possible to at least throw them into confusion and defeat the accomplishment of their task. (4) The small detachment is continually presenting a better target, is not dangerous, and can well be covered by a few men. The captain determines the target value and assignment as follows: Target I, 4 squads; Target II, 2 squads; Target III, 1 squad; Target IV, 1 squad. The captain estimates that he can accomplish something more than his "mission"; therefore he determines to take advantage of the vulnerable targets presented to him and endeavor to completely destroy the effectiveness of this hostile troop.

The captain estimates that, as the ranges obtained by the lieutenant and the range estimators practically agree, there is no necessity for the use of "ranging fire" or "combined sights," and that "fire at will" is the proper class of fire to be used. He estimates the situation as requiring the delivery of a heavy

volume of accurate fire. The increased vulnerability of the targets makes it possible to increase the standard rates without destroying fire effectiveness.

The captain determines to put all rifles in the fire fight, to open fire as soon as the various leaders are ready, and to use his last round of ammunition, if necessary, to carry out his decision.

264. The fire orders.—To first lieutenant: First platoon, firing position on this crest, your right at that fence; target, 35 dismounted men near bridge; "range 800"; rate, 10 per minute.[1]

To second lieutenant: Fifth and sixth squads, firing position on this crest, your left at that fence; target, led horses; "range 750"; rate, 12 per minute.

To Sergt. A.: Eighth squad, firing position on this crest, your right at that road; target, mounted men north of the bridges; "range 1,000"; rate, 8 per minute.

To Sergt. B.: Seventh squad, firing position on this crest to the left of the eighth squad; target, mounted men east of railroad; "range 600"; rate, 12 per minute.

The captain then directed all as follows: "Maintain your rate of fire if observation of fire determines effectiveness of sight setting. Signal when you are ready (raise hand with palm toward me). I will signal when to commence firing (arm extended moving in a horizontal plane). All will use fire at will and expend ammunition necessary to accomplish assigned missions. I will be here (about halfway between road and wire fence)."

265. A terrain exercise.—The class is taken to the west face of the hill near B and given the following situation:

Our (blue) forces from the south are engaged with the enemy (reds) who is occupying the general line Hill A–east. (Fig. 59.) A blue battalion is reconnoitering the right flank of the reds and one company, covered by combat and flank patrols, has worked its way under screen to this position. Capt. X, commanding a blue company, of two platoons, observes from this point a red battery going into position on the northwest slope of Hill A.

Requirement: The fire estimate, the fire order.

[1] Note that the range is not given first in this case because it is given to the platoon leaders and that the range estimators are estimating the range while the captain gives the orders. The platoon leaders will give the range to the men the first thing.

A SOLUTION.

266. The fire estimate.—Capt. X, upon arrival at the hill, learns the situation from Lieut. V, who is assumed to be with the point and in observation of the target. Capt. X gives orders for the company to deploy on ground indicated for a firing position just east of the road. Platoon leaders and range estimators report to the captain, and the range to nearest gun is determined to be 1,100. The captain states that he can see the location of the four guns and caissons in the "firing battery." That the guns are moving preparatory to unlimbering. The targets are all extremely vulnerable, and are of equal importance. The moving target requires a rapid delivery of fire and this can best be attained by use of individual fire. The standard rate, at this range, owing to great vulnerability of target, can be greatly increased.

It is evident that as the target is about 100 yards between flanks it must be subdivided in order that the company may get the best firing effect.

Capt. X feels that the correctness of the estimate at this range is doubtful. Furthermore, the extent of the target is longitudinal in direction, and the increased error caused by the use of combined sights will only tend to increase the depth of the beaten zone—a consideration not so objectionable when the longitudinal is greater than the lateral axis of the target.

Paragraph 217, S. A. F. M., states: "When means of exact determination are not available and indications of impact are lacking or insufficient, and the range can not be learned from the artillery or neighboring troops, some error in the range must be expected. In such case, through the expedient of combined sights, a greater depth of beaten zone may be created, giving an assurance of effect which might not be otherwise obtained. * * *"

He realizes that the vulnerability of the target will be materially reduced if he does not open fire before the guns unlimber, so he determines upon opening fire immediately upon being signaled by the platoon leaders that they are ready. He will use sufficient ammunition to put the battery out of action, or as nearly so as possible.

267. The fire orders.—First platoon, target, nearest two guns; range 1,150 and 1,050. Second platoon, target, furthest two guns; range 1,150 and 1,250. Fire at will. Rate, eight per minute. It is desired to open fire as soon as possible. I shall

signal when to commence firing. I shall be on the right flank of the company. The first sergeant, in rear of the center of the company, will transmit all signals.

NOTE.—The form of the order is intended as a guide. In the case above the company is in position so location is not mentioned. The situation demands haste in the preparation, so Capt. X announces this fact, and to be sure that he is not misunderstood he adds that, "I shall signal when to commence firing." Nothing is lost by a statement of the necessity for haste, and much may be gained in communication by stating the location of his post.

268. A problem without ball ammunition.—Capt. A marches his company to woods A, causes it to "fall out," and directs platoon leaders, range estimators, and buglers to accompany him. Upon arrival at the ridge D he presents the following situation:

"Our battalion remains at Y (some point to the west). This company has been sent forward to reconnoiter the enemy's outpost position along the ridge B–C, with a mission to develop the enemy's strength at B. Our reconnoitering patrols have gained this ridge and halted. Corp. Z reports that he saw 10 or 15 men in the heavy brush north of the road at B, and that one of the members of his patrol saw at least that number near the house just south of the road."

Capt. X directs the officers to study the terrain near B with their field glasses, the first lieutenant to the north and the second lieutenant to the south of the road. The buglers are directed to use their field glasses on the terrain near C.

All are directed to take the prone position and remain in concealment from an imaginary enemy on ridge B–C. (A few drab targets placed north and south of the road at B and near C would add materially to the exercise.)

In about two minutes the captain requires a report from each as to what details have been observed that could not have been picked up with the naked eye.

269. The captain then assumes a situation requiring fire to be opened, that trenches have been located, describes their location, and directs the estimators to obtain the range, calling their attention to the telephone posts along the roadway. He makes his fire estimate and issues his fire orders. He directs the estimators and one bugler to observe the target and the platoon leaders to join their platoons and to explain in detail to the men of their platoons the nature of the exercise. He then takes command or turns the company over to one of the officers and the exercise is carried to a completion.

CHAPTER XIX.

THE UMPIRE.

270. In order to derive the maximum benefits from an exercise, either with or without ball ammunition, it should be followed by a critique delivered on the ground immediately after the conclusion of the exercise.

271. The critique.—The umpire must know all of the details of the problem, render all necessary decisions, and deliver the critique.

It is evident that the umpire, who delivers the critique, must know all the conditions influencing the result and must be able not only to diagnose the case but to apply remedial suggestions whenever necessary.

The umpire has general charge of the exercise, sees that the data required on the form is properly kept, delivers the critique, and renders decisions whenever necessary. The umpire should be assisted by two or more junior officers in all exercises involving companies or larger organizations. These assistants should keep the record of the details of the leadership and conduct of troops, and one, accompanied by a competent signalist, should be charged with making the report on the conduct of the troops as observed from the enemy's viewpoint, use being made of a periscope when ball ammunition is used. An officer should be designated to note the statistics required in the "Umpire's record" and to record the time factor mentioned in the next paragraph.

272. The time element should be taken cognizance of—

When the situation is given out.

When the first firing position is reached.

When the fire commenced and ceased at each firing position.

Length of time in advancing from one position to another.

When any important order is given or when any incident worthy of note occurs.

In instructional firing occasions may arise when it might be well to stop the fire in order to call attention to poor control,

poor discipline, or to give any other instruction, which is always more readily understood and best absorbed when given at the time of occurrence.

The instructor or umpire should impress upon all that the fire problems during the period of instruction are not to be considered as tests, but that the problems are constructed and solved for instructional purposes only.

On some occasions in the early stages of the training, and particularly where opportunities for combat firing are limited, it may be better for the umpire to correct the sight setting announced, if it varies more than 10 per cent from the true range, than to spoil the problem by permitting the use of an incorrect setting. This with a view of saving ammunition and giving the officers and noncommissioned officers an opportunity to demonstrate their ability in direction and control and the men their training in fire discipline. In the critique it could be stated what would have been the effect had the announced sight setting been used. There is no use of having the object of the exercise defeated at its commencement by a wild estimate of the range.

It must be remembered, however, that after the instructional period is completed the fire problem with ball ammunition is the test of an officer or noncommissioned officer and a detachment in fire tactics embodying direction, control, and discipline, and in such cases the umpire should interfere as little as possible with the conduct of the action. However, he may place out of action at any time individuals or groups who expose themselves unduly.

In order that the results in any complete statistical analysis of the firing may be of value as a study and as a comparison, after firing at a target the ammunition still unfired should be checked in order to determine the number of rounds fired on any given target.

When a thorough analysis of the firing is to be made the number of rounds fired and hits made at the firing positions are absolutely essential in problems where the test is to determine fire accuracy, influence of fatigue, etc. For example, in a number of German tests it was observed, by checking the hits made at each halt, that the fire at 500 yards where rushes were commenced was more accurate than at the closer ranges where the influence of fatigue overcame the training factor.

The rate of fire in the second column of Table I, statistical records (par. 361), represents a number of shots per minute (on a target presenting to the view of the firer the vulnerable area of prone figures), which, if increased or decreased, will result in a decrease of hits per minute. The table rate of fire of the average shot is therefore primarily based on range and the vulnerable area of the prone target. In combat firing exercises the tactical situation requiring the maximum number of hits in a given time on an increased vulnerable target area is a factor which the umpire must consider in judging the rate of fire.

The umpire must present the leader of the troops with a statement of the assumed enemy-target's fire and its effect.

273. The umpire should insist that in the "setting up" of the exercise it include the targets simulating fire. This feature is one that should never be neglected, and its omission will frequently destroy the good points of the best-prepared firing problem.

In rendering a decision on the assumed effect of fire of the enemy target, the basis must be the estimated fire efficacy of average shots. The class, rate, and effect of the enemy-target's fire, assumed by the umpire, is based on the character of the leadership and conduct of the troops and their own apparent fire effect.

For example, at the commencement of an exercise, and later during its progress, the troop leader may be informed as to the enemy-target's fire, as follows:

(*a*) He is using "**Ranging**" platoon volleys on your position.

(*b*) He is opening "**Fire at will**" on you.

(*c*) He is using "**Fire faster**" at a rate of about 10 shots per minute.

(*d*) He has superiority or fire.

(*e*) His fire does not prevent your advancing, etc.

Whenever the troop leader is informed that he has not superiority of fire, he should make an estimate at once as to the cause or causes of his failure and give action immediately to his decision.

274. The umpire's ruling may have been based on one or more of the following conditions:

(*a*) Leader's indifference to enemy's fire.

(*b*) Error too great in estimation of range.

(*c*) Poor defilade or concealment.

(*d*) Rate not sufficiently high or too great.
(*e*) Size of rushing units too great.
(*f*) Lack of teamwork.
(*g*) Poor designation of target.
(*h*) Apportionment of target not clear.
(*i*) Fire not wisely distributed on the several target groups.
(*j*) General lack of fire control or discipline, etc.

In all combat firing exercises where the umpire is to express an opinion on the ground as to the results of the firing, the range and the time of firing in minutes and seconds are the essential factors in determining the proper distribution.

Under no circumstances should the umpire permit an argument as to the result of his decision. This, however, does not forbid the correction of any apparent error in the record. "It must be remembered that the decision of an umpire is rendered in accordance with his best judgment, and though the decision may appear wrong, the outcome in actual combat, due to the element of chance in war, might have been as he decided."

THE UMPIRE'S ASSISTANT.

275. In order that the umpire may draw a more accurate conclusion of the "Leadership and conduct," an assistant, accompanied by a competent signalist, should observe the troops and report on their conduct from the viewpoint of the enemy. When ball ammunition is not used, the assistant should take a position similar to and among the targets. When ball ammunition is used, the assistant should be provided with a periscope (or improvised one) and take a position in the pit or on one flank and on line with the target. In order to aid the assistant who observes the troops from the position of the enemy the following points may be noted or a memorandum given him by the umpire:

Advance of troops discerned from noticeable effect of movement in the animal and plant life, from noises, or from sounds of the voice, bugle, or whistle.

Formations, preparatory to deployment.

Groups, exposed in observation.

Deployment, under fire.

Movements by the flank of units and individuals while under fire.

Concealment of the fire director and controllers and of the various parts of the line.

Cover of the troops while advancing.

Signals (flag, arm, and hand) and conclusions drawn from the particular signal observed. For example, SSS, AM, etc.

Location of the leader by observing messengers going to or from his position or by location of signal flag near him, etc.

Individual movements in rear of the firing line.

All umpires and observers near the troops will remain in rear of the line occupied by the leader and will attach a white pocket handkerchief over the crown of their headdress, in order that the assistant observing the troops may better make his report of the exercise.

THE UMPIRE'S RECORDS.

276. There are two distinct types of records—the "umpire's record" and the "statistical record."

Two types.—The "Umpire's Record" furnishes the basis for the critique delivered by the umpire, on the ground, at the completion of the exercise, and consists of two parts. The first part covers the tactical phase of the exercise, fire direction, control, and discipline, as a result of the observation of the umpire. The second part is statistical in character and covers essential data from which the umpire draws conclusions and expresses an opinion upon the effectiveness of the fire as affecting the accomplishment of the mission.

Simplicity of form.—The data for this record should be of such a character that it can be obtained quickly without reference to long formulas, numerous tables of factors, etc. It must be as simple as the Umpire's Record in a maneuver problem, if not simpler, for the critique based upon this record is never carried into the "lecture tent," but delivered on the ground.

277. The umpire's record should embody sufficient data concerning the troops on which to base a decision as to—

1. **Leadership and conduct.**
   - A. **Judged from the position of the troops.**
   - B. **Judged from the position of the target.**
2. **Fire effect.**
3. **The accomplishment of the mission.**

As an aid in delivering the critique a printed form covering the principal points to observe in the leadership and conduct of troops should be provided.

The following form has been found convenient for this purpose. Umpires should remember that this form is simply a

reminder in general terms and that all the detailed points given in Chapter I herein are to be considered.

UMPIRE'S RECORD OF COMBAT FIRING FOR CRITIQUE.

Organization_____ commanding.

Exercise_____. Order_____. Date_____

1. LEADERSHIP AND CONDUCT.

278. The major:

General—

(*a*) Effective supervision of battalion.
(*b*) Harmonizing ranges.
(*c*) Tactical orders.
(*d*) Regulating ammunition supply.
(*e*) Control of supports.
(*f*) Primary apportionment of target.
(*g*) Provision for flank protection.
(*h*) Observation of enemy and adjoining troops.
(*i*) Depth of deployment, extent and density of firing line.
(*j*) Fixing bayonets.
(*k*) The charge.

In attack:

(*a*) Selection of formation in which to advance.
(*b*) Direction of advance.
(*c*) Objective for each company.
(*d*) The general object or special problem for each company of the order and front of each company.
(*e*) The base company.
(*f*) Time or place for opening fire.

In defense:

(*a*) Assignment of sectors.
(*b*) Determination of ranges.
(*c*) Communication to company.

279. The captain, first sergeant, and buglers:

(*a*) Leader's knowledge of the situation.
(*b*) Explanation of the situation to the company.
(*c*) Reconnaissance of the target.

(*d*) Use of field glasses.
(*e*) Dangerous grouping of platoon leaders and range estimators.
(*f*) Estimation of range.
(*g*) Designation and apportionment of target.
(*h*) Clearness of fire orders to subordinates.
(*i*) Advance of the unit to first firing position.
(*j*) Concealment.
(*k*) Time of preparation from receipt of situation to "Commence firing."
(*l*) Observation of fire effect.
(*m*) Correction of material errors in sight setting.
(*n*) Orders, if any, for distribution of ammunition. Its economical and judicious expenditure.
(*o*) The position of first sergeant and buglers and duties performed.
(*p*) Time of cease firing.
(*q*) Signals.

280. The platoon leaders and guides:

(*a*) Execution of the captain's commands and directions.
(*b*) Announcement of correct sight setting.
(*c*) Clearness in designation of target or aiming point.
(*d*) Additional instructions given to carry out captain's will.
(*e*) Correction of sight setting.
(*f*) Designation of an aiming point.
(*g*) Observation of fire effect.
(*h*) Use of field glasses.
(*i*) Orders to platoon guides.
(*j*) Use of signals.
(*k*) Constant communication between the platoon leaders and captain.
(*l*) Observation and regulation of the rate of fire.
(*m*) Their positions.

281. The corporals:

(*a*) Alertness for commands and signals. Proper transmission of signals.
(*b*) Observation of the conduct of the squad.
(*c*) Assistance in enforcing fire discipline and abatement of excitement.
(*d*) Participation in the firing.
(*e*) Their positions.

282. The privates:

(*a*) Use of cover.

(*b*) Excitement or confusion.

(*c*) Use of sight setting announced and changes directed.

(*d*) Firing on designated objective or in the assigned sector and change of target when directed.

(*e*) Readily responding to the signals, particularly "Commence firing," "Suspend firing," and "Cease firing."

(*f*) Unnecessary cessation of fire, particularly when bayonets were being fixed, sight setting changed, or when supports joined the firing line.

283. Fire effect. (See umpire's reference tables, Chap. XXVI.)

Data.	Targets.				
	1	2	3	4	5
ACCURACY.					
True range					
Estimated range					
Direct hits on assigned targets					
Ricochet hits on assigned targets					
DISTRIBUTION.					
Figures in target					
Figures hit (direct hits)					
VOLUME.					
Number of men firing					
Number of shots fired					
Time					
Rate					
COMPARISON—AVERAGE SHOTS.					
Figures hit					

GENERAL COMMENT.

2. Was the mission accomplished? (This decision must be based on a consideration of leadership and conduct and fire effect.)

(Umpire)

It will be noted that the umpire's record as explained herein contains all of the data (except number of hits expected) referred to in "Records," paragraph 226, S. A. F. M., and that the excepted data is contained in the "Statistical record."

CHAPTER XX.

PRELIMINARY EXERCISES.

(Without ball ammunition.)

284. Under no circumstance should an officer or man be allowed to participate in a fire problem wherein ball ammunition is used until after he has passed through and been found proficient in a thorough preliminary course of training.

Ammunition expended in fire problems by organizations that have not received this preliminary training is ammunition wasted.

The individual known distance course of target practice is a demonstration of the thoroughness and correctness of the man's preliminary training. In a like manner any problem should be a demonstration of the perfection attained by the company in the preliminary training without ball ammunition as a whole in all that relates to fire direction, fire control, and fire discipline.

As an illustration, the case may be cited of a class of 75 recruits at the school of musketry, that was given a course of preliminary instruction along the lines indicated herein, after which the class was formed as a company under platoon and squad leaders selected from the class and given a firing problem involving the securing of the firing data, the issuance of orders, and the execution of the order by the men. There was absolutely no criticism to be made of the methods of direction, control, and discipline. Therefore lack of range facilities and ammunition should not be offered as an excuse for insufficient training in combat firing, as it is perfectly practicable to have an organization well trained in musketry without having fired a shot in a fire problem.

However, unless such a course is supplemented by further exercises with ball ammunition, the organization will not know that it is well trained and hence will be lacking in the confidence that such knowledge brings. Exercises with ball ammunition are essential if for no other purpose than to confirm the preliminary training.

The following exercises and those given heretofore are offered as suggested methods in teaching:

These exercises are for the most part taken from those used at the School of Musketry, and have consequently all been tested. Their use should suggest other similar and more advanced exercises.

EXERCISES.

285. The construction of these exercises should follow the same general principles as for fire problems with ball ammunition, Chapter XXI.

286. I.—**Object:** Estimation of front of a definite extent at various ranges.

Method: Company commanders will be shown a line and informed: "Somewhere on the line a squad of men representing the right (left) of a hostile line will appear. You will open fire on this hostile line covering a front of 50 (100) yards."

The company commander will determine and announce the range according to the method of paragraph 240, I. D. R. He will then determine the extent of front he is directed to cover. and, having done so, will sight two rifles, resting on sandbag rests, so that one will be directed at the right and the other at the left of the line which he has determined as the extent of front he is to cover. The aiming tripod, figure 33, may be used.

In estimating fronts the musketry rule, rear sight, or finger system may be used.

Standards of proficiency: Estimation of ranges, 90 per cent; estimation of front, 90 per cent.

287. II.—**Object:** Exercise in harmonizing ranges used throughout a given firing line.

Method: The company commanders with their "range estimators," all in the prone position, will be assigned to an outlined position where the fire fight is to start. The battalion commander will be assigned a position from which he can control, through his company commanders, the opening of fire. On the appearance of the target, a hostile skirmish line, ranges will be estimated as prescribed in paragraph 240, I. D. R., "Time" 50 seconds. The battalion commander will then find out the determined ranges by use of the signal, "What range are you using," and announce the harmonized range. Ranges will be signaled (par. 43, I. D. R.). When the last company

commander has repeated the battalion commander's signal the exercise will be closed.

Time: No time allowance. The exercise will be completed as soon as practicable.

288. III.—**Object:** Designation of targets.

Method: The company will be conducted to a place a few yards from a point where the target is visible. Its captain will be shown the target. He deploys the company, advances it to the position for opening fire, and gives the necessary firing data, including description of target, assignment of portions of it to platoons, etc.

Platoon leaders will give the necessary firing data to their platoons. The men will set sights and aim at the proper target and sector as understood by them.

In describing indistinct targets any method, mil rule, rear sight, finger, or clock systems may be used.

The exercise is repeated for three different targets.

289. IV.—**Object:** The use of auxiliary aiming targets.

Methods: An indistinct target will be selected, the flanks of which are marked by signal flags. The company commander is brought to a position from which he can observe the outlined target. The flags will then be ordered down, when the company commander points out to his range estimators and platoon leaders the target from the observing station, determines the range and gives the command for opening fire on the objective, including, for the purpose of instruction, the announcement of an auxiliary aiming target and the consequent sight setting.

Any mechanical device may be used as an aid in this work.

290. V.—**Object:** Accurate and quick sight setting and the use of combined sights.

Method: A well-defined target will be used at a range of over 1,000 yards. The company commander will be shown the target. He then determines the range in the usual manner. The company will be deployed facing the target and the usual firing data given (in this case, on account of time limit, all commands will be given by company commander).

The company commander is in the prone position. Time is taken from the last word of command announcing the sight setting. Fifteen seconds later the command "time" will be given by the officer in charge of the exercise. At this command, whether sights are set or not, all rifles will be laid on the

ground and left untouched until examined. This concludes the exercise.

291. VI.—**Object:** Teaching fire direction.

Elements included: Use of ground, designation of target, determination of front occupied by target, assignment of sectors to platoons, determination of the range, determination of kind of fire to be used, causing fire to be opened at proper time.

Method: The company is marched to a place near the point selected for the problem; the position selected is under cover. The company commander is called up and given a problem similar to the following situation: "The enemy, a battalion acting alone, is in position along a line extending east from that fence corner. You will deploy your company here and direct its fire on that portion of the hostile line which is occupied by a 10-squad deployed company and whose right rests at that fence corner."

The captain conducts his company so as to carry out the orders or directions given him, using suitable tactical formations.

The exercise is ended immediately after fire is opened. For purposes of comparison and comment the following will be noted:

(*a*) Time elapsing between receipt of problem and opening fire.

(*b*) Exposure to hostile fire while securing and transmitting firing data and while deploying.

(*c*) Clearness in description of target and its division into fronts.

(*d*) Extent to which the captain's will, as expressed in his firing data, is carried out by the company.

292. VII.—**Object:** Fire control. (Par. 250–253, I. D. R.)

Method: The company will be marched to an indicated point where a tactical situation will be presented involving the principles of fire control.

For the purposes of comparison and comment the following will be noted:

(*a*) The captain's general application of the principles of fire direction.

(*b*) The detailed elements of fire control as given in Chapter I, herein.

(*c*) Time elements.

293. VIII.—**Object:** Fire discipline.

Method: The company is marched to an indicated point where a tactical situation will be presented.

For the purposes of comparison and comment the following will be noted:

(*a*) Use of ground.

(*b*) Target designation.

(*c*) Determination of front of target.

(*d*) Assignment of objectives to platoon.

(*e*) Determination of range.

(*f*) Kind of fire used.

(*g*) Causing fire to be opened at proper time.

(*h*) Reinforcement of firing line.

(*i*) Fire discipline. Ability of men in firing line to transmit firing data (location of target, what the target is, what portion to fire at, range to be used, rate of fire to be employed) to reinforcements when they arrive on the firing line, and to do this without any marked cessation in the rate of fire.

For this exercise two platoons will be on the firing line, deployed at one-pace intervals, the other two platoons constituting the support; after fire has been opened, the firing line will be reinforced in such a manner that the men of the support will occupy the intervals between the men on the firing line. Firing data will be transmitted from man to man. Twenty seconds later the original firing line will be withdrawn at the command of the director. The reinforcing line will then set their sight at the range given them and 10 seconds later, at the command of "Time," will aim their rifles at what they believe to be their portion of the target.

The sight setting and the aiming of the rifles will then be verified and the probable value of the fire determined.

294. IX.—**Object:** To apply all the principles of fire direction, fire control, and fire discipline covered in previous exercises, and in addition the use of suitable means to maintain fire superiority during advances of the firing line, particularly the proper distribution of fire cover of the entire target during rushes.

295. Object: The application of all the principles of fire direction, fire control, fire discipline covered in previous exercises and in addition the particular application of the various prescribed methods of communication.

Method: The company is assigned a mission requiring it to take up a position and to open fire on an advancing column.

The situation will be so drawn as to bring out some of the authorized methods of communication.

Company and platoon commanders will not use the voice when any part of their unit is firing, nor at any other time when their will can be expressed by a signal.

Pertinent paragraphs on the subject of communication are as follows:

Paragraphs 31, 33, 35, 41, 42, 43, 47, 384–388, I. D. R., paragraph 32, F. S. R.

296. XI.—**Object:** Supply of ammunition of firing line (problem to involve in its solution all of the principles covered in previous exercises).

Method: The battalion commander will be handed a tactical situation requiring a march in the presence of an active enemy and later an attack on this enemy's position. It will be conducted by means of the prescribed commands and signals, in accordance with the rules laid down in I. D. R. under the heading " Fire " and "Attack," paragraphs 303 to 319.

The battalion will be at war strength, accompanied by its combat train; machine gun company and five mounted orderlies attached.

Combat train loaded as prescribed in Tables of Organization for supplies other than ammunition.

Before going into action packs will be dropped and left under suitable guard (368, I. D. R.). Other pertinent paragraphs are 294, 418, and 419, I. D. R.

CHAPTER XXI.

THE CONSTRUCTION OF FIRE PROBLEMS.

297. A fire problem is an incident or phase in the solution of a tactical problem and should always be so treated.

The preparation of a fire problem requires not only a sound knowledge of tactical principles and the requisite experience in constructing tactical problems, but also a detailed knowledge of the theory of rifle fire and of targets and ranges. In the preparation of a problem the following points should be considered:

PREPARATION.

298. (*a*) The problem should be so constructed as to impart a lesson in fire tactics.

(*b*) The strength of the fire unit should be determined in connection with the tactical lesson to be taught.

(*c*) A tactical situation should be selected that will best illustrate the lesson to be imparted. It is believed that the fire problems in general should present one phase of an action. For example, firing on artillery, on moving bodies, opening of an attack, carrying the exercise to the second firing position. On extended well-equipped B ranges it will be possible to work out a shifting scene of action, presenting a number of new targets to an advancing line, or advancing targets to a stationary line.

(*d*) An estimate should be made of the sight setting that should be used and the rate of fire that should be employed.

(*e*) The ground and the direction in which the firing will occur should be considered. The terrain, whenever possible, should be new to the commander. The securing of a great variety of terrain will usually be impracticable, but there can be presented to the commander new situations involving the use of different targets at different points.

(*f*) Attention should be given to the targets that will be employed, having special reference to those that may be available. The target should generally be equal to approximately the num-

ber of men or to the front of the detachment firing. If not, it creates a false impression. For instance, a company of 100 rifles firing on a target of 20–30 yards in width, but targets greater in number than the firers, are sometimes used in order to determine whether or not the fire was confined to a particular sector or objective, as directed, or more frequently where the troops are on the defensive and the targets are simulating an attack.

Targets should be placed in a formation corresponding to the phase of the action. Ordinarily the figures should be placed one to every yard of front. The enemy will take care to expose himself as little as possible. It will be unusual to have a row of kneeling figures to fire upon at the close ranges. Close-order bodies in all probability would remain a target for a very short period of time. Artillery targets should be spaced with about 20 yards interval. Cavalry charges might be represented by targets appearing in succession at 800 yards, at 700, at 600, at 500, etc., each line disappearing from view a few moments before the next appears.

(*g*) The amount of ammunition necessary to bring about the result desired should be the result of calculation. The number of cartridges issued should be enough to disable theoretically a selected percentage of the targets. If 3,000 rounds are required to disable about one-third of the targets and 1,500 rounds are issued, then only about 15 per cent of the figures can be expected to be hit. This failure would rest on the problem maker and not on the troops. For determination of number of rounds to be carried by each man (see paragraph 373).

(*h*) Notation should be made of the time element for the particular unit involved and its bearing upon a time schedule for organization which may follow in the solution of the same problem.

(*i*) The time element, in connection with the duration of fire, must be determined by first deciding on the rate of fire to be used at that range, consideration being given to the tactical requirements and to the vulnerable area of the target. For example, if a proper rate be eight per minute, then the number of cartridges to be given to each man, divided by eight, will give the number of minutes firing. This calculation forms the basis for the time element and is better than a pure guess, even though a liberal allowance be made for the difference between practical and theoretical time.

(*j*) To insure fresh situations for each commander, every effort must be made to keep those next to fire from receiving information about the problem.

(*k*) The question of pits to be constructed and the necessary details to carry out successfully the plans adopted should be given weight and all possible economy made of men and material.

(*l*) The problem should be tested to determine if it can be solved in a manner that would prevent the desired lesson from being taught.

FORM.

299. Tactical situation.—The situation should present a simple logical scheme. This gives an opportunity to judge of the tactics employed and while the fire feature of the problem must receive proper consideration it is to be remembered that no effect should be expected with an organization conducted tactically in such a manner that it could not reach the firing position.

MISSION.

300. It should be definite, and logically emanate from a simply-represented situation.

The requirement ordinarily might include: (*a*) An estimate of the situation; (*b*) an order based on this estimate; (*c*) the execution of this order.

In map problems, terrain exercises, etc., (*a*) and (*b*) usually will be oral or written, while (*c*) may include such features of the execution as do not include firing.

When ammunition is used (*a*) would be mental, (*b*) would be given by word of mouth or by signal, and (*c*) would be carried out in its entirety.

CHAPTER XXII.

AN EXAMPLE OF THE CONSTRUCTION, SOLUTION, AND CRITIQUE OF A FIRE PROBLEM (BALL AMMUNITION).

301. Details of procedure.—Maj. X was detailed by the commanding officer to prepare a combat-firing problem with ball ammunition. Upon receiving this order Maj. X prepared the following:

302. Statement of the problem (see fig. 58).—**Troops:** One company of infantry.

Situation: Two hostile units are engaged in a fire fight. The hostile unit is reinforced on one flank.

Object: The primary object is to give practice in directing part of the fire of the company to cover a secondary objective, at the same time keeping the main objective covered with a well-distributed and proper volume of fire. Secondarily, it gives practice in quick decisions, target designation, quick change of objective, requiring rapid estimate of fire data, and rapid issuing and transmission of orders for firing, use of signals, use of the battle sight, and the principles of fire direction, control, and discipline.

Time: [1] The umpire causes the fire to cease one minute after the exposure of the second target or two minutes after the first shot is fired.

Target: Main objective. A line of 80 prone figures (target F) range about 600 yards. Secondary objective: A line of 20 prone figures range about 500 yards. Figures in both objectives on a frontage of 1 yard per figure.

[1] Percentage of figures desired struck, about 50 for the first minute of firing on each target. From prone table (par. 365) on 600-yard line 48, the nearest to 50, is found in the one-minute column, and from the same table on 500 B. S. line 50 is found in the one-minute column, so two minutes is selected as the firing time.

Ammunition: [1] Twenty rounds of ball ammunition, per man, carried in the belt.

Critique: Principal points.

Note assignment of targets to platoon leaders in order to properly distribute the fire on the main objective.

Note method to bring fire to bear on secondary objective.

303. Situation for leader.—Your battalion commander has sent your company forward under the following order: "A civilian reports that about 50 of the enemy occupy the ridge at 'B' and that about two hostile companies are halted at a stream about a mile east of 'B.' Combat patrols now cover your right and left flanks. Attack the enemy at 'B' and drive him from his position. I shall move the remainder of the battalion south and east and attack the enemy reported at the stream. I shall maintain communication with you."

304. Requirement—Execution of the order.—Having decided upon the character of the problem, Maj. X goes over the ground where from memory he knows his problem can be adapted to the terrain. This action is to insure himself that no small folds of the ground, vegetation, etc., will interfere with the conduct of the problem as planned.

Target.	Range.	Time.	Rate (from Table 1).	Rounds.
Main objective	600	2	7.5	15
Secondary objective	500	1	8.3	8

Upon request of Maj. X, three battalion staff officers were directed to report to him for instruction. Two were assigned, one each to two platoons, to observe the fire control of the corporals and the fire discipline of the privates, and the third, accompanied by a competent signalist, was assigned to observe the conduct of the troops, from the viewpoint of the enemy, by means of a periscope in the pit.

305. Maj. X prepared the following memoranda for the adjutant, to be delivered to the range officer and to the commander of the company selected for the fire problem:

(1) The maximum number of rounds per man required will be the amount needed by those men who fire for one minute on the main objective and then switch to the secondary objective for one minute, or 7.5 plus 8.3, a total of 15.8. Adding 10 per cent and issuing full clips, the estimate would be 20 rounds, which would be a sufficient number of rounds for each man. (Par. 372-373.)

Confidential memorandum from the adjutant to First Lieut. Y, range and statistical officer: "You will prepare the range for a combat problem. Copy of the situation and memorandum to Capt. A inclosed herewith. Targets: 80 F targets on ridge at B. Target 'I' three beams 20 F targets, concealed at C ready to appear on signal 'up' from Maj. X. Firing position at 'A.'"

The points, A, B, C, E, and X are indicated on range map and well known to Lieut. Y.

306. Memorandum from the adjutant to Capt. A: "The commanding officer directs that you report with your company in the field equipment, 20 rounds ball ammunition per man, to Maj. X, at E, at 7 a. m., February 21, 1916."

Upon arrival at E Capt. A presents Maj. X with a statement of his company's strength and organization which was as follows:

1 company commander and 2 buglers.
4 platoon leaders (2 officers).
6 platoon guides.
10 squad leaders.
70 rifles in the firing line.
Total, officers 3, enlisted men 90.

Organized into four platoons—first and fourth platoon three squads each, second and third platoon two squads each.

Maj. X informs Capt. A that he will have five minutes in which to explain the situation to his company. He directs the captain "to load" in the present position of the company.

A SOLUTION.

307. The fire estimate.—Capt. A calls his company to "At ease," then reads his problem carefully and explains the situation to all. The captain directs Sergt. R to take charge of the company and the platoon leaders and range estimators to join the captain. Upon arrival near the crest the target is located, and all who have glasses sweep the front for further details. The range estimators announce the range. The captain selects the firing position for the company and directs Sergt. R (the platoon leaders are with the captain) to deploy the company, indicating where the right shall rest. He determines upon the sight setting and upon the assignment of targets, using the lone tree on the ridge B as a reference point in the apportionment of the target. He decides that the class of fire shall be "Fire at will" and the rate to be the ordinary rate at this range, at least

until he is convinced by the observation of the fire effect that the sight setting is correct and that the vulnerability of the target permits a higher rate.

He notes the woods to his left front and decides to caution the fourth platoon leader for particular observation in that direction for concealed targets. He determines to open fire as soon as platoon leaders signal "Ready."

He decides to take station on the left of the line to observe the fire and study its effect.

The fire orders.—*Target:* That line of prone figures on that ridge, width 134 mils.

Reference point: That tree ("D" pointing out same).

First and second platoons, target 70 mils wide, 35 mils each side of the tree.

Third and fourth platoons, target 70 mils wide, commencing 30 mils toward 9 o'clock from the tree.

Each platoon will cover the entire target assigned to the two platoons.

The fourth platoon will observe the woods to our left front.

Fire at will.

Sergt. M will be in rear of the center of the company to receive and transmit signals.

I shall be on the left of the line.

Capt. A later signals "Commence firing." At the end of one minute's firing Maj. X signals "up," or telephones to the pit, and the secondary target at "C" comes up. Capt. A signals the leader of the fourth platoon "Battle sight" and "Swing cone of fire one finger (one sight leaf or 50 mils) to the left" and signals the third platoon "Fire faster."

308. At the end of the second minute Maj. X causes "Cease firing" to be sounded.

The pit record was as follows:

	Figures hit (direct hits).	Direct hits.	Ricochets.
Target 1	40	75	8
Target 2	9	13	2

Two battalion staff officers who were assigned each to two platoons to observe the fire control of the corporals and the fire discipline of the privates make their report to Maj. X.

Maj. X, preparatory to delivering the critique, directed Capt. A to briefly outline his observation of the exercise, particularly with respect to causes, if any, for factors which may have reduced the effectiveness of the fire.

309. Capt. A stated as follows: I feel assured now that my announced sight setting was too great. I believe that it should have been decreased at least 50 yards. However, I think that the number of hits on the main target was about average. The fire seemed well distributed, although I believe that the first platoon's target received the greater number of hits. The rates seemed about correct. The lack of control in the third platoon was due to Sergt. E's lack of musketry training.

Referring to the lettered subheads of the umpire's record (par. 378), Maj. X delivered the following critique:

310. (1) **Leadership and conduct.**—The captain, first sergeant, and buglers:

(*a*) The situation was thoroughly understood by the captain.

(*b*) His explanation to the company was not clear. Probably the result of not talking sufficiently loud to be heard by all. At least 10 men stated that they did not hear the capain.

(*c*) The target was well reconnoitered.

(*d*) Field glasses were properly used.

(*e*) During the time that the estimators were obtaining the range and the captain was making his fire estimate, the captain, platoon leaders, and estimators were dangerously grouped.

(*f*) The sight setting announced was 50 yards over the true elevation. This was probably due to the fact that the target was in a clouded light, and that it was not clearly defined against a favorable background. (Par. 81, S. A. F. M.)

(*g*) The designation of the target seemed clear.

(*h*) The fire orders were clearly stated, but the captain failed to announce the rate, which is a function of fire direction. The rates used seemed about correct.

(*i*) The advance of the third platoon crawling to the crest was poorly carried out; more concealment should have been obtained. The advance of the first platoon was excellent. There was too much talking going on in the third platoon. This caused some confusion. The seventh and eighth squads deployed too slowly. Paragraph 124, I. D. R., states that the men deploy "moving at a run."

(*j*) The second and third platoons moved too far to the front, sacrificing better concealment and gaining nothing in the fire position.

(*k*) The preparation consumed 10 minutes. Considering the situation, this is too long and is mainly due to lack of proper utilization of time, and the slowness in making the fire estimate. The time would have been reduced had the captain issued his orders to the platoon leaders while the estimators were obtaining the range. The deployment of the company could have been ordered as soon as it was apparent where would be the firing position.

(*l*) The captain did not utilize the buglers in observing the enemy, the target, and fire effect. (Par. 235, I. D. R.)

(*m*) On account of the dust near the enemy's right and rear of the target the shot strikes should have been visible to the captain or buglers and the error in sight setting corrected.

(*n*) It is thought that the ammunition distribution between the two targets was excellent.

It is thought that the deflection of but one platoon's fire on the new target was excellent and that ammunition was wisely expended.

(*o*) See (*l*) above. The first sergeant led the second platoon. Sergeant M did not receive and transmit signals as promptly as should have been done.

(*p*) Firing ceased two minutes after first shot was fired and one minute after second target appeared.

(*q*) The signal "Swing cone of fire to the left" should have been made with the palm of the hand to the left, pointing in the direction of the new target.

311. Platoon leaders and guides:

(*a*) Commands and directions were carried out.

(*b*) Correct sight setting was announced.

(*c*) The designations of the target given by second and third platoon leaders were not clear; it is evident that the third platoon leader has no idea of the "Finger system."

(*d*) No additional instructions to carry out the captain's will seemed necessary except as noted in (*e*) below.

(*e*) The first platoon leader "lowered" 50 yards. The other platoon leaders made no correction.

(*f*) No aiming point was necessary.

(*g*) The observation of fire effect by the third platoon leader was very poor. In the fourth platoon there was too much

observation for a probable new target and not enough for fire effect. The observation of the first platoon leader was excellent.

(*h*) Glasses were used with good effect.

(*i*) With the exception of the order given by the first platoon leader, to his platoon guide, viz, "In addition to your regular duties you will keep in constant communication with the captain," there seems to have been no particular use made of the platoon guides. None of them properly performed their duties except the guide of the first platoon.

(*j*) The arm-and-hand signals, as a general rule, were made too quickly, accuracy giving way to speed. This caused some confusion and delay. Exactness of execution must be demanded in all arm-and-hand signaling. One has no time to solve arm puzzles.

(*k*) The second, third, and fourth positions at time were out of constant communication with the captain.

(*l*) See (*h*) under heading "Captain" above. The first and fourth platoon leaders announced a rate, but no attempt seemed to have been made to regulate it.

(*m*) The positions of the platoon leaders were such that they could easily control their platoons.

312. Corporals:

(*a*) The corporals of the sixth and seventh squads were not on the alert for commands and signals. The corporal of the eighth squad transmitted the signal "Commence firing" improperly.

(*b*) The corporals of the first, second, and third squads showed a high state of training in the conduct of their squads. The corporals of the sixth, seventh, and eighth squads need special musketry instruction.

(*c*) As a rule, the corporals did not enforce fire discipline, due principally to the lack of instruction in how to carry out this duty.

(*d*) The corporals did not participate in the firing. It is thought that by not doing so they were better able to perform the duties with which they were charged.

(*e*) Eight of the corporals were slightly in rear of the center of their squads, their heads being near the feet of the men to the front. Two were on the line. The former position seems better from which to control the conduct of their squads.

313. The privates:

(*a*) A number of men in the third platoon did not take the best cover obtainable. They were too far to the front.

(*b*) There was too much confusion in the third platoon, due to unnecessary talking. The inefficiency of some of the squad leaders had the natural result of causing some of the squads to develop self-appointed leaders, creating the usual confusion apparent in bodies that are weakly led.

(*c*) Eight men were checked as not taking the announced sight setting.

(*d*) About five men of the third platoon were checked firing on the target assigned to the first and second platoons. The left of the third platoon changed targets without command when the second target appeared.

(*e*) About five men fired after "Cease firing" had been ordered.

(*f*) There was practically a cessation of fire in the first platoon when the leader signaled "Lower 50 yards."

314. Maj. X then directed Lieut. Z, who had observed the conduct of the troops from the pit, to read his notes, which were as follows:

7.06 a. m.: Several head of cattle were seen to run from under cover of ridge A, as if they had been driven out. Later I heard two blasts from whistles of different tones.

7.07: A group of about seven men could be seen near the clump of bushes on ridge A. Two were observing with field glasses.

7.08: The arm signal "As skirmishers" was observed made by one of the above group.

7.09: The line appeared crawling to the ridge crest. The right seemed to be as well concealed as the ground would permit, the left center was badly exposed, and made an excellent target. The whole line seemed too far advanced.

7.10: Observed on three or four occasions what I thought to be platoon guides or squad leaders, in crouching positions, move in rear of the line.

7.11: Firing opened; range seemed over at first, but decreased later with apparent good effect.

7.12: I located the company commander by observing a messenger leave him and go to the rear. I was later convinced of his position by the man near him, presumably a bugler, displaying a signal flag. From the white square on the red field, I assumed the organization to be Company A.

I read a message signaled with a handkerchief from the left of the line: "Enemy in woods to our front."

There was a noticeable cessation of fire at one time in the right of the line.

The command "Fire faster" was heard distinctly.

7.13: I read a signal AM wigwagged with the hat by some one in rear of the left of the line—probably the platoon guide of the left platoon. This information was unusually important, as it showed an ammunition scarcity after about two minutes' firing.

The estimated strength of the firing line was 66 rifles—determined with musketry rule, knowing the range 600, and reading the width of the line in mils, 110. (Width of the line in yards equals the range in yards multiplied by the width of the line in mils divided by 1,000.)

Maj. X then announced the statistical part of the umpire's record, as shown below, and commented thereon as noted:

315. Fire effect.—

Data.	Targets.				
	1	2	3	4	5
ACCURACY.					
True range	600	500	.....	.....	.....
Estimated range	650	B. S.	.....	.....	.....
Direct hits on assigned target	75	13	.....	.....	.....
Ricochet hits on assigned target	8	2	.....	.....	.....
DISTRIBUTION.					
Figures in target	80 F.	20 F.	.....	.....	.....
Figures hit (direct hits)	40	9	.....	.....	.....
VOLUME.					
Number of men firing	[1] 60	[1] 21	.....	.....	.....
Number of shots fired	900	168	.....	.....	.....
Time	2	1	.....	.....	.....
Rate	7½	8	.....	.....	.....
COMPARISON—AVERAGE SHOTS.					
Figures hit	[1] 42	[1] 10	.....	.....	.....

[1] See par. 317.

316. General comment.—Judgment of the result:

Target 1.—Estimated visibility 700.

Average shots, at the true range, would have struck 50 figures, and with a visibility of "700 yards" 42 figures.

You struck 40 figures.

Target 2.—Estimated visibility normal. (Pars. 317 and 340.)

Average shots, at the true range, would have struck 10 figures. You struck 9 figures.

Your performance seemed about equal to average shots and is considered satisfactory.

3. **Was the mission accomplished? Yes.**

A——— B———,
Captain 66th Infantry,
Umpire.

317. Memorandum—Explanatory of the comparison:

Company strength, 10 squads, first and fourth platoons, 3 squads each.

Corporals in rear of line.

70 rifles in the firing line.

Target 1. 80 F, range 600. Visibility 700.

70 men firing 1 minute.

70 men less 21 (fourth platoon) firing 1 minute.

70 plus 49 equal 119.

$\frac{119}{2}$ equal $59\frac{1}{2}$, say 60 men firing 2 minutes.

There are 60 men firing 2 minutes on 80 targets; reducing the men and the targets to the same number in order to get the time factor for reference to table, we have 80 men firing on 80 prone targets for $1\frac{1}{2}$ minutes and from the table, 700-yard line, the percentage of figures hit shows 53, or 42 targets.

Target 2. 20 F, range B. S. (500). Visibility normal.

Target was exposed for 1 minute. Twenty men (21) firing 1 minute on 20 prone figures at range 500 with the battle sight.

From the table 50 per cent, or 10 targets.

CHAPTER XXIII.

SITUATIONS FOR FIRE PROBLEMS.

318. The examples given here are for the purpose of instruction, but it is only by actual construction and solution of problems that the subject is mastered.

The following situations are offered as an aid in the preparation of problems:

319. A blue company on combat reconnaissance has worked its way around the right flank of the red position, and on arrival at *B* observes a red battery about to unlimber at *A*. (Fig. 59.)

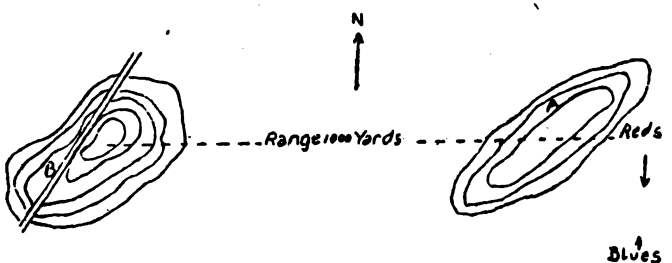


FIG. 59.

320. A company of infantry is reconnoitering the enemy's outpost position with a mission to develop the enemy's strength at *B*. (Fig. 60.)

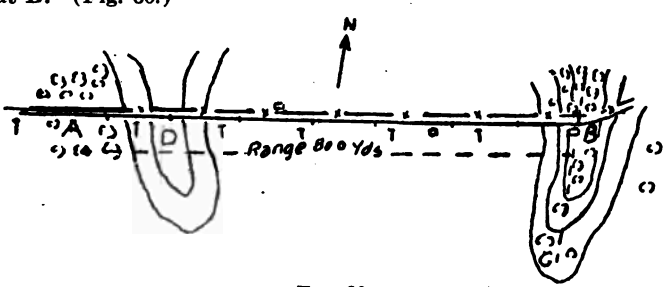


FIG. 60.

321. Two hostile units are engaged in a fire fight. The hostile unit is reenforced on one flank. (Fig. 61.)

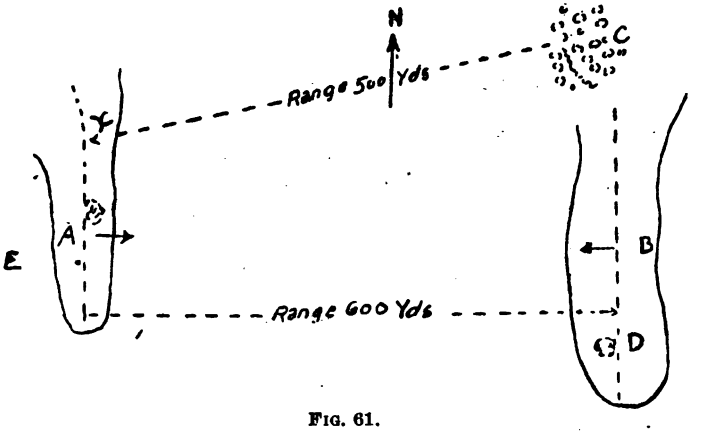


FIG. 61.

322. A red unorganized force occupies windows and tops of buildings on north side of plaza. A blue company from A has deployed at *B–C*. (Fig. 62.)

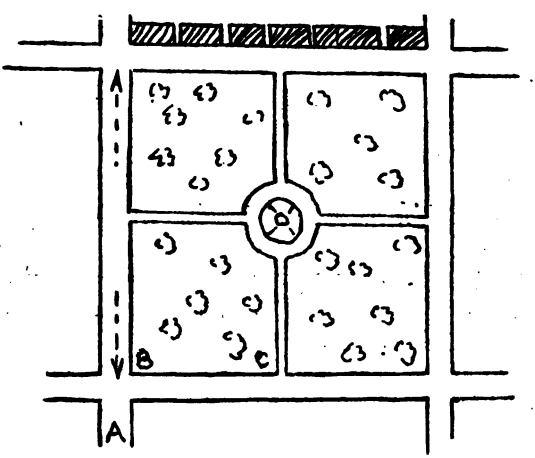


FIG. 62.

322. A rear-guard battalion is deployed at *C*. The pursuing enemy has appeared at *A*. (Fig. 63.)

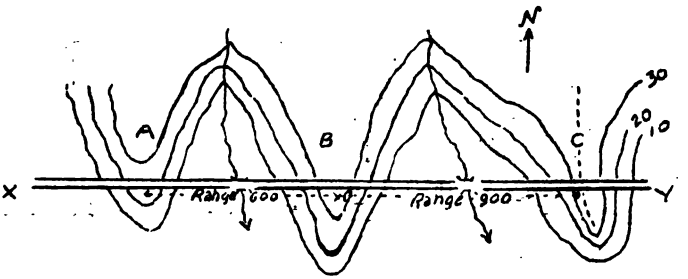


FIG. 63.

324. A battalion is sent from B to cover the left of the blue position. On arrival at *A* two red companies are seen advancing through the brush in squad columns. (Fig. 64.)

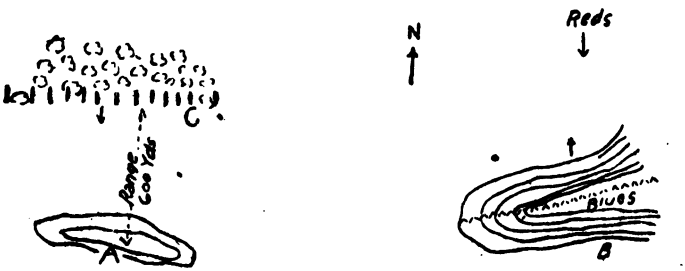


FIG. 64.

325. A blue advance guard battalion, upon arrival at *A*, is directed to halt, cover bridges, and prevent enemy crossing. Enemy about ¾ mile west of bridges, now approaching. (Fig. 65.)

326. The reds have taken up a concealed position on the west of hill *A*, whose face is covered with a uniform brush. The blue leader from *B*, with his field glasses, has located the reds along the 30-foot contour. (Fig. 66.)

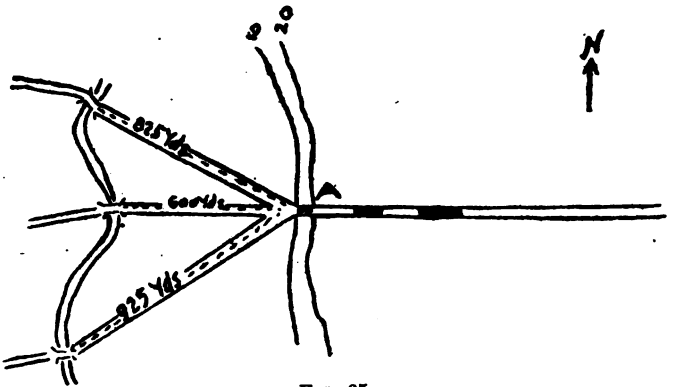


FIG. 65.

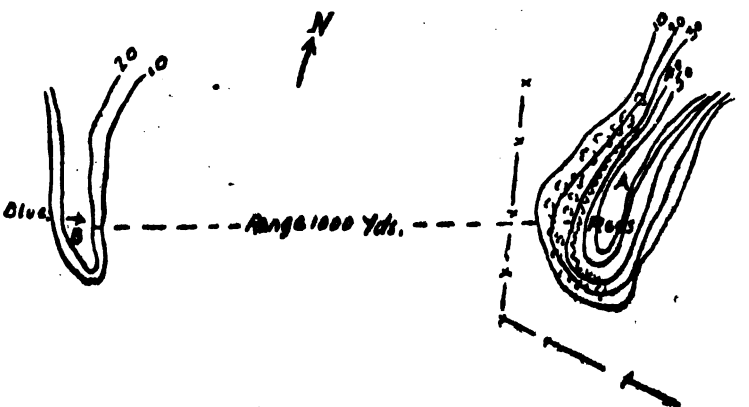


FIG. 66.

327. A blue battalion is intrenched at *A–A* to prevent hostile landing. Shells are falling on and near intrenchments from a ship east of *E*. (Fig. 67.)

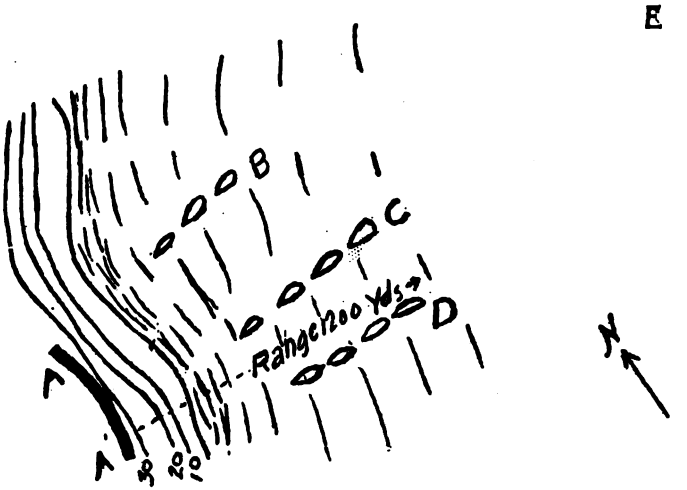


FIG. 67.

328. A blue regiment has reached *D*, advancing toward an enemy intrenched at *A*, with mission to first conduct a holding attack until the rest of the brigade has launched the main attack from a flank. (Fig. 68.)

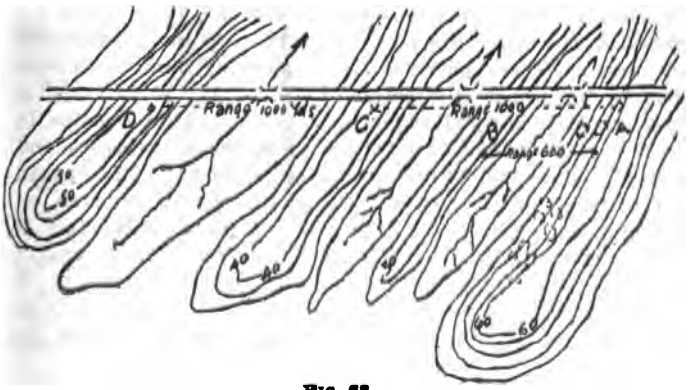


FIG. 68.

CHAPTER XXIV.

PROBLEMS SUITABLE FOR A CLASS A RANGE.

329. The following are illustrative of the kind of problems that may be fired on a class A range:

FOR THE SQUAD.

Object: To illustrate the leadership of the squad.

Situation: One squad is sent from an outpost in enemy country into an open field to round up and drive in a herd of cattle grazing near a small hill (the parapet) about 1,000 yards in front of the outpost line. A small hostile patrol (three men) was seen in the vicinity of the hill yesterday.

Action: The squad advances in the indicated direction in the formation directed by the corporal. When it has advanced about 200 yards firing is heard in the direction of the hill and the umpire informs the corporal that one of his men has been hit. The umpire directs one man to fall out and remain prone. Simultaneously with the firing a small patrol appears (three men) near one side of the range, and remains in view 30 seconds. Forty seconds later the patrol appears again for 30 seconds and more firing is heard. If the corporal opens fire and advances, the enemy patrol retreats, appearing three times, each time for 30 seconds at intervals of 40 seconds. If the corporal does not open fire and advance, the enemy patrol remains in its first position and at intervals of 40 seconds appears and fires. No shots will be fired except as ordered by the corporal.

Targets: Four lines of silhouettes in echelon, mounted on disappearing apparatus. First line, 3 prone silhouettes 2 yards apart; second line, 3 prone silhouettes 4 yards apart; third line, 3 prone silhouettes 6 yards apart; fourth line, 3 silhouettes 8 yards apart, all of the silhouettes measured from center to center. Distance between lines, front to rear, 50, 75, and 90 yards. Distance to first line about 700 yards.

Ammunition: Five rounds per man.

FOR THE PLATOON.

330. Object: To illustrate the leadership of a platoon.

Situation: One platoon of four squads is sent from an outpost in enemy country to cut down some trees from which an enemy patrol fired on one of our outguards yesterday. There is no cover for 700 yards in front of our line.

Action: The platoon advances in the indicated direction in the formation directed by the platoon leader. When it has advanced about 200 yards firing is heard and at the same time a hostile patrol appears near one side of the range. The umpire directs two men to fall out, and informs the platoon leader that they have been hit. If the platoon opens fire a second hostile patrol appears on the opposite side of the range, and if the platoon continues firing both patrols retreat.

Targets: First patrol—4 lines in column, each line consisting of 8 prone silhouettes on disappearing apparatus, 1 yard apart between centers at distances from front to rear of 60, 80, and 100 yards. Distance to front line about 700 yards. The first appearance of the first line is for 30 seconds. At intervals of about 30 seconds it continues to appear and fire until fire is opened by the platoon. After fire has been opened by the platoon the first line remains in view for 30 seconds. The second, third, and fourth lines of targets then appear at intervals of 30 seconds, each line remaining in view about 30 seconds. Second patrol—same as for first patrol, except the silhouettes will be kneeling and the distance to the first line will be about 775 yards. The second patrol does not appear until fire has been opened on the first patrol. The appearance of the second patrol is accompanied with firing from its direction.

Ammunition: 15 rounds per man.

FOR THE COMPANY (OFFENSIVE).

331. Object: To illustrate fire direction, control, and discipline.

Situation: A company is ordered to attack an enemy whose position is indicated to the company commander.

Action: The company will be deployed in line of skirmishers about 1,200 yards from the pits under command of the captain. The umpire will indicate the first firing position and direct the captain to move his company forward and open fire. One min-

ute and a half after the company opens fire it will cease firing and the targets will be marked. The number of targets struck will be signaled to the umpire, who will determine whether fire superiority has been gained. Should the company have failed in this respect it will remain in position and fire for another minute and a half, continuing in this position and firing for periods of a minute and a half until the ammunition is expended or fire superiority gained. In case fire superiority is gained, three minutes will be given for the next period of fire, during which the company will be required to advance not less than 50 yards, the details of the advance being left to the captain. Following the advance the umpire will determine whether fire superiority has been retained. If not, the company will remain in position as at the beginning. This procedure will continue until the ammunition has been expended.

Target: A line of prone silhouettes, equal in number to the number of men in the firing line, 1 yard apart, center to center, resting on the ground, and placed about 900 yards from first firing position.

Ammunition: 30 rounds per man.

The distance gained and the number of figures hit during this exercise might be used as a basis for judging the relative proficiency of the companies of a regiment. This would furnish a stimulus that would add to the interest of combat firing.

When favorable soil exists for a trench of proper dimensions to be constructed the targets for the exercise outlined above could be so arranged and manipulated that it would be unnecessary for the company to cease firing in order to ascertain whether or not fire superiority had been gained.

The beam-disappearing target would be arranged in this pit by resting the beams on pieces of timber placed crosswise in the pit and sunk sufficiently deep to allow only the visible part of the target to be seen flush with the ground. Four beams should be fastened together so that one man from a central position could operate 32 targets. Two lines of figures pointing in opposite directions would be fastened to each beam so that a turn of 180 degrees would expose first one line and then the other.

After firing was begun, each line of targets would alternately be exposed one minute. From the number of targets hit each minute, an officer in the pit would determine when fire superiority had been gained and whether it was being kept. By a system of flag signals this information would be read at the

firing point. After opening fire the company would remain stationary until fire superiority had been gained, when it would be allowed to advance in any formation desired by the captain. If fire superiority were lost, all elements would halt in place until they were able again to gain the advantage.

FOR THE COMPANY (DEFENSIVE).

332. Object: To teach quick estimation of distances, quick sight setting, study of the foreground, and apportionment of target.

Situation: A company in an entrenched position is ordered to fire on an advancing enemy.

Action: The company being in position, the umpire calls up the first target, which is the signal for the company to commence firing.

Targets: Four lines of prone silhouettes on disappearing apparatus—number of silhouettes equal to the number of men firing, 1 yard apart between centers. The four lines placed in column at distances of 90, 75, and 60 yards from rear to front. Distance to first target about 900 yards. The first target remains in view one and one-half minutes after fire has been opened, when it disappears. At intervals of 30 seconds the second, third, and fourth targets appear and remain in view one and one-half minutes each.

Ammunition: 30 rounds per man.

Time: The time for preparing for the first opening of fire will be taken from the appearance of the first target.

The average distance of the targets, the total number of figures hit, and the total time of actual firing will form a basis for the umpire to determine whether or not the company gained fire superiority.

CHAPTER XXV.

THE STATISTICAL OFFICER.

THE STATISTICAL RECORDS.

333. The statistical record of combat firing is kept by the statistical officer under the direction of the umpire.

Disposition.—The statistical officer makes such disposition of the records as the umpire may direct.

334. The form.—The form shown below is a convenient one, though no particular form is prescribed. It is believed, however, that the data included on this form is essential to a thorough analysis of any firing.

The columns headed "Target 1," "Target 2," etc., may be used to record the results on several targets, on a single target from several firing points, on several fractions of a single line, or, when the firing is at a single target from a single firing point, to record the results obtained by successive "orders," thus keeping, on a single sheet, the results of as many repetitions of the same exercise as there are columns in which to record them.

In case certain items of the record are found to be not pertinent to certain exercises, they may be omitted at the discretion of the umpire.

STATISTICAL RECORD OF COMBAT FIRING.

Organization.....Commanding.
Exercise.....Order.....School of Musketry, Fort Sill, Okla.....19....

DATA.

Hits.	Target 1.	Target 2.	Target 3.	Target 4.	Target 5.
Hits:					
Direct, in sector or on assigned objective					
Richochet, in sector or on assigned objective					
Outside sector					
True range					
Visibility					
Estimated range					
Firing data used:					
Elevation					
Deflection					
Aiming point					
Figures in target:					
Number and kind in sector or objective					
Number per yard of front					
Struck by richochets only					
Struck outside sector or objective					
Center of impact					

THE CRITIQUE—REMARKS ON STATISTICAL RECORD—RESULT COMPARED WITH STANDARD.

[Same time and strength.]

	Standard.	Result.	Standard.	Result.	Standard.	Result.	Standard.	Result.	Standard.	Result.
Accuracy										
Hits										
Distribution										
Figures struck										
Volume										
Rate										
Time										
Shots										
Men										

Richochets included (yes or no).....

COMPARISONS ON OTHER BASES.

(*a*) Comparative strengths										
(*b*) Comparative time										
(*c*) Hits expected for shots fired										
(*d*) Distribution expected for hits made										

....., *Statistical Officer.*

STATISTICAL OFFICERS' SOURCES OF INFORMATION.

336. The information required by the statistical officer for the completion of his record is obtained, in general, by observation: From the umpire, from the range officer, from the commander of the firing unit, by computation.

By observation:

Estimated range.
Firing data used.
Time.

From the umpire:

Visibility.
Ricochets included, yes or no.

From the range officer:

True range.
Number of figures in target per yard of front.
Number and kind of figures within the sector or assigned objective.
Hits, direct and ricochet, obtained within and without the sector or assigned objective.
Figures struck within and without the sector or assigned objective.
Figures struck by ricochets only.
Center of impact.

From the commander of the unit firing:

Number of men firing.
Number of shots fired.

By computation:

Such further entries as are required in the record he obtains by computation.

ENTRIES IN THE RECORD.

337. Entries in the record should include hits, true range, visibility, estimated range, firing data used, figures in the target, center of impact.

338. Hits.—After the firing is completed and the targets have been marked the statistical officer secures a record of the hits obtained, direct and ricochet, within and without the sector or assigned objective, from the range officer or from the signal squad, as is most convenient. In case the statistical officer's post is some distance from the signal station, then arrangements should be made to have this information sent to him promptly by messenger.

In case all the figures in the target lie within the limits of the objective or sector, then obviously there would be no entry on the line "outside sector."

Whether or not ricochets are to be scored and recorded separately will depend upon the nature of the exercise and will be decided in each case by the umpire. However, it must be noted that the tables are based on direct hits only.

339. True range.—This is obtained from the range officer, and should be the result of an exact measurement, not an estimate.

340. Visibility.—The tables from which the standard of comparison is obtained, as explained hereafter, are based upon the hypothesis that the target or aiming point is clearly visible, thus expressing the probable maximum of expectancy.

When this condition does not exist—and it seldom does in field firing—it becomes necessary to modify the standard by reducing it to meet existing conditions. The amount of this reduction is termed the "visibility," and is the opinion of the umpire expressed in terms of range. For example, the true range to a target being 600 yards, the umpire may estimate the visibility as "650." That is to say, it is his belief that the conditions are such that the probable maximum result to be expected is the same as when firing at a clearly visible target at 650 yards and that the standard is to be computed on that basis.

341. Estimated range.—The estimated range may or may not agree with the sight setting announced.

During the progress of the exercise, the statistical officer remains in the vicinity of the commander of the unit engaged in the practice and, by close observation, learns the estimated ranges. Should the result of his observation leave him doubtful as to the correct figures, he may inquire of the unit commander after the firing is completed or at such other time as not to interrupt the progress of the exercise.

342. Firing data used.—

Elevation,
Deflection,
Aiming point.

The statistical officer obtains this information in the same manner in which he obtains the estimated range, i. e., by observation and inquiry.

When an auxiliary aiming point is used, it is recorded briefly as "tree," "bush," "rock," "house," "hedge," etc., and it

sometimes may be of advantage also to note its distance and direction from the target. This may be done by recording the distance (in mils) in Arabic numerals, followed by the direction (clock notation—target at center of vertical clock) recorded in Roman numerals. Thus "Tree–50–IV" would mean that the aiming point was a tree 50 mils from the target in the direction of 4 o'clock.

343. Figures in target.—

Number and kind in sector, or assigned objective.
Number per yard of front.
Struck by richochets only.
Struck outside sector, or assigned objective.

This information is obtained by the statistical officer from the range officer. The first two items may be obtained from the statement of the exercise.

344. Center of impact.—This information is obtained from the range officer or from the signal squad, as is most convenient. The statistical officer is informed as to whether the fire was equally distributed throughout the entire front of the target or was concentrated in one or more well-defined shot groups. The record should be brief, and, merely for the sake of uniformity, the following abbreviations are suggested. With reference to the target, R, L, and C refer to its right, left, and center:

Right	R
Left	L
Center	C
Right center quarter	RC/4
Left center fifth	LC/5
Center third	C/3
Right half	R/2
Distributed	Dist.

Should there be any apparent necessity for more precise information than can be given in this manner, it is better to divide the front of the objective into several parts and to obtain a separate record of the hits and distribution in each part. Certain exercises might require that a record be kept of the number of hits on each figure in the target. In such cases this information would be recorded on a separate sheet and attached to the record, when entries in the body of the record might lead to confusion or misunderstanding.

345. Result compared with standard.—There are several standards by which the material results of combat firing may be

judged, but the one here used is an expression of the probable result to be expected from an equal number of average shots firing at the correct range and with the correct elevation and for the same length of time.

Entries under standard should include hits, figures struck, rate, time, shots, men, ricochets included, yes or no.

To compute the standard the statistical officer must have at hand the following data:

Visibility.
Time, or duration of the fire, in minutes.
Number of men firing.
Number and kind of figures in the target.

An example will serve best to show the method of arriving at the standard.

Assume the following data: Range, 500; visibility, 650; time, 2 minutes; men, 100; figures in target, 100, kneeling.

346. Hits.—Consult Table I (par. 361). In the left-hand column, headed "Range yards," find the figure "650" (visibility). Follow this 650 line to the right until entering the subcolumn "Kneel" (kinds of figures in the target) in the column "Number of hits." Here is found the amount "1.074," which is the number of hits to be expected from one average shot in one minute. This amount multiplied by 2 (time) gives 2.148, or the number of hits to be expected from one average shot in two minutes. This product multiplied by 100 (men) gives 214.8, which is the number of hits to be expected from 100 men firing for 2 minutes and is the standard sought. Fractions less than one-half ordinarily are disregarded, and so this would be recorded as 215.

347. Figures struck.—Taking the probable number of hits (215) as the basis, first find the number of times each figure in the target would be struck on the average. As there are 100 figures in the target and there are 215 hits, then 215 divided by 100 would give the average number of hits per figure, or 2.15. Consult Table II. In the column "H" find the amount 2.15. Then the amount on the same line in the adjacent column "D" to the right expresses the percentage of figures in the target that should be struck with a fire equally distributed throughout the entire front of the objective. In the present instance the amount 2.15 is found in column H. Disregarding fractions less than one-half, the amount taken from column D is 88. As this amount expresses percentage only, and as it is

number that is sought, then 88 multiplied by the number of figures in the target (100) and this product divided by 100 will give the number of figures that should have been struck. In this case, as the number of figures in the target is an even 100, the number and percentage are the same, 88. Using the umpire's reference table, kneeling figures, and interpolating for range 650 in the 2-minute column, the percentage is found to be 88.

348. Rate.—The expected rate of fire, expressed in shots per man per minute, is found in Table I at the intersection of the line corresponding to the visibility 650 with the column headed "Rate of fire." In this example it is 7.0.

349. Time.—The time recorded under "Standard" and under "Result" are identical—i. e., it is the actual duration of the fire in minutes.

The statistical officer often will find his computations simplified if in recording the time he will express fractional parts of a minute decimally instead of as seconds.

350. Shots.—This is the number of shots that would have been fired had the correct rate been used. Multiply the rate by the time and this product by the number of men.

In this example 7 (the rate as found in the table) times 2 (the time in minutes) times 100 (the number of men firing) equals 1,400, which is the number of shots that should have been fired.

351. Men.—This is the number of men in the firing line who did or should have used their rifles in the exercise in question. The men recorded under "Standard" and "Result" are the same.

352. Ricochets included, yes or no.—Under certain conditions it might be expected that a given number of ricochets would occur in addition to the direct hits found from Table I. In such a case the umpire would decide upon whether or not he desired to consider the ricochets separately, and if so, he would notify the statistical officer as to the percentage to be expected. The recording of this amount as "20 per cent," for example, under "Standard" would indicate that ricochets were to be included and that 20 per cent were to be expected in addition to the direct hits. If the umpire decides that ricochets are not to be considered, then the word "No" appears in place of the percentage.

In case ricochets are considered, the statistical officer increases the expected hits as found in the table by the percentage of ricochets as announced by the umpire. He then uses this increased number of hits in his further computations.

The entries under result should include hits, figures struck, rate, time, shots, men, ricochets included, yes or no.

353. Hits and figures struck.—These amounts are the ones obtained from the range officer, as explained above, and include ricochets or not as directed by the umpire.

354. Rate.—This is the rate of fire actually obtained, and is found by dividing the total number of cartridges fired by the product of the men and time.

355. Time, shots, men.—This is merely a record of fact as to the duration of the fire, the total number of shots fired, and the number of men in the firing line who did or should have used their rifles during the exercise.

356. Ricochets included, yes or no.—This is a statement as to whether or not the results recorded under hits and figures struck include ricochets. It would be unusual to include ricochets in the standard and not in the result, or vice versa.

357. Comparisons on other basis should include comparative strengths, comparative time, hits expected for shots fired, distribution expected for hits made.

Comparative strengths.—A given firing line produces a given number of casualties in the enemy's ranks (strikes a given number of figures in the target) in a given time. What is sought then is how many riflemen of average ability, using the correct elevation and rate and distributing their fire equally throughout the entire front of the target, will be required to produce the same number of casualties in the same time.

This may be found from the "Umpire's reference tables" as explained in Chapter XXVI, or, if more precise results are desired, by the solution of the following equation:

$$M_s = \frac{H}{B} \frac{N}{T F^i}$$ in which

M_s is the number of men (standard conditions) producing equal results.

H is an amount found from the distribution table, Table II, as hereinafter shown.

N is the number of figures in the target—within the sector, or assigned objective.

B is an amount found from Table I, as hereinafter shown.

T is the time or duration of the fire in minutes.

F is the number of figures in the target per yard of front.

To find the value of H, multiply the number of figures struck by 100 and then divide this product by the number of figures in the target. Consult Table II and find an equal amount to this quotient in column D. The amount on the same line, in column H to the left, is the value of H sought.

Example:

Number of figures in target, 50.

Number of figures struck, 26.

Then $26\times100\div50=52$, and in the column D of Table II (fourth column from the left) is found the amount 51.8, which is the closest approximation of 52. In the column H, to the left and on the same line, is found the amount 0.73, which is the value of H sought.

To find the value of B, consult Table I. In the column "Number of hits," select the appropriate subcolumn depending upon the kind of figures (kneeling or prone) in the target. The value of B sought will be found at the intersection of this subcolumn with the line corresponding to the visibility.

Example:

Prone figures.

Visibility, 800.

Follow the 800 line to the right until entering the column "Number of hits, prone," there is found the amount, 0.384, which is the value of B sought.

Example of use of equation:

Number of figures struck, 43.

Number of figures in target, 65 kneeling.

Visibility, 950.

Figures in target per yard of front, ½.

Time, 2 minutes.

Substituting in the equation.

$$M_s=\frac{1.08\,(H)\times65\,(N)}{0.474\,(B)\times2\,(T)\times\frac{1}{2}\,(F)}=\frac{70.20}{.474}=148$$

That is, it would take 148 average shots to strike 43 out of 65 kneeling figures in two minutes.

358. Comparative time.—How much time should be used by average shots of a given number to strike a given number of figures.

This can be found in the same manner as the comparative strength from the umpire's reference table or with greater precision by a transposition of the above equation to read—

$$T_s = \frac{HN}{BMF}$$

The values are the same as in the original equation except that T_s is the time or duration of the fire in minutes (standard conditions) producing equal results.

359. Hits expected for shots fired.—Consult Table I. Multiply the perecentage of hits, as found on the line corresponding to the visibility, by the number of shots fired. The product is the number of hits expected for shots fired.

360. Distribution expected for hits made.—Solve as "figures struck" under "Standard."

361. Statistical officer's tables.—The rate of fire and the percentage and number of hits on the prone and kneeling figures expected at each range are shown in Table I. The percentage of figures in a linear target that should be struck by an evenly distributed fire, based on the average number of hits per figure, is shown in Table II.

Table I.

[Black figures indicate "battle sight."]

Range, yards.	Rate of fire.	Per cent of hits.		Number of hits.	
		Prone.	Kneel.	Prone.	Kneel.
200	10.833	20.05	33.41	2.172	3.619
		18.52	**33.05**	**2.006**	**3.580**
250	10.416	16.78	29.19	1.748	3.041
		16.01	**28.61**	**1.668**	**2.980**
300	10.000	14.49	25.87	1.449	2.587
		14.08	**25.59**	**1.408**	**2.559**
350	9.583	12.91	23.40	1.237	2.242
		12.89	**22.41**	**1.235**	**2.148**
400	9.166	11.67	21.40	1.070	1.962
		11.62	**19.72**	**1.065**	**1.808**
450	8.750	10.79	19.88	.944	1.740
		10.05	**16.13**	**.980**	**1.411**
500	8.333	10.00	18.57	.833	1.547
		8.30	**12.86**	**.692**	**1.072**
550	7.916	9.30	17.35	.736	1.374
600	7.500	8.65	16.22	.649	1.217
650	7.083	8.05	15.16	.570	1.074
700	6.666	7.54	14.17	.503	.945
750	6.250	7.03	13.27	.439	.829
800	5.833	6.59	12.45	.384	.726
850	5.416	6.18	11.71	.335	.634
900	5.000	5.78	11.00	.289	.550
950	4.583	5.42	10.34	.248	.474
1,000	4.166	5.12	9.77	.213	.407

362. The degree of precision desirable in the use of this table is dependent upon the duration of the fire and upon the amount of ammunition expended. In "Rate of fire" and "Number of hits" use one place of decimals when firing less than 5 minutes, two places when firing less than 10 minutes, and three places when firing more than 10 minutes. In "Per cent of hits" use no fraction when less than 100 shots are fired, one place of decimals when less than 1,000 are fired, and two places when more than 1,000 are fired.

The amounts in the body of the table under "Rate of fire" indicate shots per man per minute when firing at the correct rate.

The amounts under "Per cent of hits" indicate the percentages of hits to be expected from average shots on lines of prone or kneeling figures occupying a frontage of 1 yard per figure. For different spacing of the targets multiply the amount in the table by the number of figures per yard of front.

The amounts under "Number of hits" indicate the number of hits to be expected from one average shot in one minute (correct rate and elevation being used) on lines of prone or kneeling figures occupying a frontage of 1 yard per figure. For different spacing of targets multiply the amount given in the table by the number of figures per yard of front.

The amounts in the body of the table are based upon the further supposition that the targets are clearly visible.

Table II.

H.	D.	H.	D.	H.	D.	H.	D.
0.01	1.0	0.31	26.7	0.61	45.7	0.91	59.8
0.02	2.0	0.32	27.4	0.62	46.2	0.92	60.2
0.03	3.0	0.33	28.1	0.63	46.7	0.93	60.6
0.04	3.9	0.34	28.8	0.64	47.2	0.94	60.9
0.05	4.9	0.35	29.5	0.65	47.8	0.95	61.3
0.06	5.8	0.36	30.2	0.66	48.3	0.96	61.7
0.07	6.8	0.37	30.9	0.67	48.9	0.97	62.1
0.08	7.7	0.38	31.6	0.68	49.4	0.98	62.5
0.09	8.6	0.39	32.3	0.69	49.8	0.99	62.8
0.10	9.5	0.40	32.9	0.70	50.3	1.00	63.2
0.11	10.6	0.41	33.6	0.71	50.8	1.02	63.9
0.12	11.3	0.42	34.3	0.72	51.3	1.04	64.7
0.13	12.2	0.43	34.9	0.73	51.8	1.06	65.4
0.14	13.1	0.44	35.6	0.74	52.3	1.08	66.0
0.15	13.9	0.45	36.2	0.75	52.8	1.10	66.7
0.16	14.8	0.46	36.9	0.76	53.2	1.12	67.4
0.17	15.6	0.47	37.5	0.77	53.7	1.14	68.0
0.18	16.5	0.48	38.1	0.78	54.2	1.16	68.6
0.19	17.3	0.49	38.7	0.79	54.6	1.18	69.3
0.20	18.1	0.50	39.4	0.80	55.0	1.20	69.9
0.21	18.9	0.51	40.0	0.81	55.5	1.22	70.5
0.22	19.7	0.52	40.5	0.82	56.0	1.24	71.1
0.23	20.5	0.53	41.1	0.83	56.4	1.26	71.6
0.24	21.3	0.54	41.7	0.84	56.8	1.28	72.2
0.25	22.1	0.55	42.3	0.85	57.3	1.30	72.7
0.26	22.9	0.56	42.9	0.86	57.7	1.32	73.3
0.27	23.7	0.57	43.4	0.87	58.1	1.34	73.8
0.28	24.4	0.58	44.0	0.88	58.5	1.36	74.3
0.29	25.2	0.59	44.6	0.89	58.9	1.38	74.8
0.30	26.0	0.60	45.1	0.90	59.3	1.40	75.3

Table II—Continued.

H.	D.	H.	D.	H.	D.
1.42	75.8	2.05	87.1	4.50	99.0
1.44	76.3	2.10	87.7	5.00	99.3
1.46	76.8	2.15	88.4	.....	.....
1.48	77.2	2.20	88.9	5.50	99.5
1.50	77.7	2.25	89.5	6.00	99.8
1.52	78.1	2.30	90.0	.....	.....
1.54	78.6	2.35	90.4	.....	.....
1.56	79.0	2.40	90.9	.....	.....
1.58	79.4	2.45	91.4	.....	.....
1.60	79.8	2.50	91.8	.....	.....
1.62	80.2	2.55	92.2	.....	.....
1.64	80.6	2.60	92.6	.....	.....
1.66	81.0	.....	.....	.....	.....
1.68	81.4	2.65	92.9	.....	.....
1.70	81.7	2.70	93.3	.....	.....
1.72	82.1	.....	.....	.....	.....
1.74	82.4	2.75	93.6	.....	.....
1.76	82.8	2.80	93.9	.....	.....
1.78	83.1	.....	.....	.....	.....
1.80	83.5	2.85	94.2	.....	.....
		2.90	94.5	.....	.....
1.82	83.8	.....	.....	.....	.....
1.84	84.1	2.95	94.8	.....	.....
1.86	84.4	3.00	95.0	.....	.....
1.88	84.7	.....	.....	.....	.....
1.90	85.0	3.25	96.4	.....	.....
1.92	85.3	3.50	97.8	.....	.....
1.94	85.6	.....	.....	.....	.....
1.96	85.9	3.75	98.3	.....	.....
1.98	86.2	4.00	98.7	.....	.....
2.00	86.5	.....	.....	.....	.....

If every figure in the target is hit H times on the average, then from the table, D per cent of the figures will be hit.

CHAPTER XXVI.

THE UMPIRE'S REFERENCE TABLES.

364. Distribution factor.—The considerations influencing the effect of fire are numerous, and while some of them can be clearly shown in terms of hits made or figures struck, there are many which must be based entirely on observation and opinion. However, so soon as the **principal factors** are known, from a consideration of the record of any firing, a trained umpire can at once express an intelligent decision as to the probable result of the action. What is wanted is a *prompt decision* from the best obtainable judgment as to the efficacy of the fire and the solution of the fire problem.

In order to add force to the decision, it is sometimes advisable to make a comparison with average shots. In order that this comparison may not involve "complicated calculations" various tables have been compiled in order that the percentage of figures struck may be taken from the table at a glance and without computation. The compiled table represents the result expected from average shots firing at a correct maximum rate and distributing their fire perfectly while using the correct sight setting.

It must be remembered that the accomplishment of the mission in a fire problem is based usually on the number of targets disabled. The "comparison," therefore, is based on this factor.

365. The two tables which follow, if printed on both sides of a card of convenient size are of value to umpires, not only as a ready reference in judging of the results of fire, but also in formulating problems with ball cartridges.

There are problems in which the use of these tables would be neither feasible nor necessary, and others in which the decision of the umpire is amply supported by his own judgment. Hence it is not to be understood that the use of these tables is in any sense mandatory, but rather that when the umpire believes their use possible and desirable they may serve him as a guide in arriving at a decision or as a standard whereby he may fortify or confirm a decision already made.

Umpire's reference table.

[NOTE.—Amounts in body of table indicate the percentages of figures that should be struck. Those in black indicate "battle sight."]

PRONE FIGURES.

Range, yards.	Time, minutes.															
	¼	½	¾	1	1½	2	2½	3	3½	4	5	6	10	15	20	25	30
200	42	66	80	89	96	99	99	100	....	....	....	....	....	....	....	....	....
	39	**63**	**78**	**87**	**95**	**99**	**99**	**100**	....	....	....	....	....	....	....	....	....
300	30	52	66	77	89	94	98	99	99	99	100	....	....	....	....	....	....
	30	**51**	**65**	**76**	**88**	**94**	**98**	**99**	**99**	**99**	**100**	....	....	....	....	....	....
400	23	41	55	66	80	88	93	96	98	99	99	100	....	....	....	....	....
	23	**41**	**55**	**66**	**80**	**88**	**93**	**96**	**98**	**99**	**99**	**100**	....	....	....	....	....
500	19	34	46	57	71	81	88	92	95	97	99	99	100	....	....	....	....
	16	**29**	**40**	**50**	**65**	**75**	**82**	**87**	**91**	**94**	**98**	**99**	**100**	....	....	....	....
600	15	28	38	48	62	73	80	86	90	92	95	98	100	....	....	....	....
700	12	22	31	40	53	63	72	78	83	87	92	95	99	100	....	....	....
800	9	17	25	32	44	54	62	68	74	79	85	90	98	99	100	....	....
900	7	13	19	25	35	44	51	58	64	68	76	82	94	99	99	100	....
1,000	5	10	15	19	27	35	41	47	54	57	66	72	88	96	99	99	100

KNEELING FIGURES.

Range, yards.	Time, minutes.												
	¼	½	¾	1	1½	2	2½	3	3½	4	5	6	10	15
200	60	84	93	98	99	100	....	....	....	....	....	....	....	....
	59	**83**	**93**	**98**	**99**	**100**	....	....	....	....	....	....	....	....
300	48	73	86	93	99	99	100	....	....	....	....	....	....	....
	47	**72**	**85**	**92**	**98**	**99**	**100**	....	....	....	....	....	....	....
400	39	63	77	86	95	99	99	99	100	....	....	....	....	....
	36	**59**	**74**	**84**	**93**	**98**	**99**	**99**	**100**	....	....	....	....	....
500	32	54	69	79	90	96	98	99	99	100	....	....	....	....
	24	**41**	**55**	**66**	**80**	**88**	**93**	**96**	**98**	**99**	**99**	**100**	....	....
600	26	46	60	70	84	91	....	99	99	99	100	....	....	....
700	21	38	51	61	76	85	91	94	97	98	99	99	100	....
800	17	30	42	52	66	77	84	89	92	95	98	99	100	....
900	13	24	34	42	56	67	75	81	85	89	94	97	99	100
1,000	10	18	26	33	46	56	64	71	76	80	87	91	99	100

USE OF TABLES IN JUDGING RESULTS OF FIRE.

368. General use in judging results.—All tables of expected results are based on the theory of probability. The tabulated results are therefore "probable" results. Any concrete case is as likely to result in a higher as in a lower figure, and in a great number of cases there will be as many on one side of the "probable" as on the other.

This fact applied to tables of expected hits from average shots means that average shots firing an indefinite number of identical problems will have an average result in direct hits equal to that shown in the table, but with as many results below as above the "probable." When it is sought to compare the result attained by a firing group in a concrete case with the tabulated probable result of average shots, it should be remembered that the average shots themselves in the firing would often attain a number of hits higher (or lower) than the probable, and that the purpose of the comparison with the probable is merely that there may be some standard of comparison. One would not expect average shots to hit upon this same standard every time they fired, nor would one expect the firing group in any concrete case to do so. Judgment is needed to determine whether the departure in the concrete case is normal or abnormal in amount. The fact that it is above or below is absolutely immaterial, it is only the amount of the departure that is of value in forming a judgment from the comparison.

369. Description.—The amounts in the body of the table indicate the percentages of figures that should be struck by any number of average shots firing at an equal number of figures arranged to represent a linear target occupying a front of 1 yard per figure. These results are based, too, on the further assumption that the correct elevation and rate of fire is used, that the fire is distributed equally throughout the entire front occupied by the target, and that the visibility is normal.

Of these seven factors the following four are dependent upon the skill and leadership of the firers, i. e., the use of correct elevation and rate of fire, the equal distribution of the fire, and the marksmanship of the individual rifleman (whether he is good, average, or poor shot). As these factors are, in a sense, within the control of the firers, they may be considered as constant in so far as the use of the table is concerned, or, rather, variable only in that they would serve to indicate whether the performance had been good, bad, or indifferent.

The other three factors—number of figures in the target, number of figures in the target per yard of front, and the degree of visibility of the target—may vary with every target and exercise, and visibility may vary even for the same target at different hours of the day.

The object of these tables is to give to the umpire a means, with the minimum computation, of finding a standard with which

to compare the results of any firing. The standard adopted is the single amount representing the percentage of casualties that *should* have been obtained in the ranks of the enemy (number of figures in the target that should have been struck) in a given time.

In order that the percentage of figures hit can be read directly from the table and thus avoid any unnecessary computations in the field, it is suggested, when the character of the problem permits, that the target contain as many figures as there are rifles firing and that the figures be spaced on a frontage of one per yard.

370. Normal conditions.—

Example 1.—At a range of 900 yards 100 men fire for two minutes at a line of 100 kneeling figures on a front of 100 yards. Visibility perfect. In this firing they strike 24 figures.

What is the judgment of this result?

Consult the table headed "Kneeling figures."

In the column headed "Range, yards," find the amount 900. Follow this line to the right until entering the column headed "2" (this corresponds to the time, 2 minutes, during which the fire continued), where is found the amount 67, which is the percentage of figures that should have been struck. How does this compare with the result that was obtained?

First reduce the percentage of figures that should have been struck, 67, to number of figures, in this case 67.

Then at a glance the umpire can see that, in the allotted time, the firing resulted in a little more than one third the casulties it should have produced.

371. Variable conditions.—

Example 2.—Reduced visibility.—Fifty men fire at 50 prone figures—normal front—for 2 minutes at a range of 600 yards. The figures are not well defined. It is manifest that the same results can not be expected on a target of this character as in one that is clearly visible, hence it would seem advisable to lower the standard. It is only a question of how and how much. This is a matter resting entirely upon the judgment of the umpire who makes an estimate of the increased difficulties presented to the firers and arrives at a decision which he expresses simply as an opinion, "The visibility of the target is such in this problem that a reduction of efficiency is to be expected. In my judgment the firing of this organization is satisfactory (deficient, etc.)."

Should the umpire wish to base this opinion upon a computation he may do so in the manner shown below.

The umpire, knowing the range to be 600 yards, for example, says to himself, "While this actual range is 600 yards, the targets appear to me to present all the difficulties of a clearly visible target at 800 yards and, as there is no aiming point that can be used which is as clearly outlined as the targets themselves, I will judge of this firing by the 800-yard standard."

Assume that the fire resulted in 20 figures being struck. Then in the table at the intersection of the *800*-yard line and the 2-minute column is found the amount 54, which is the percentage that should have been struck—in this case 27 figures.

Example 3.—Number of firers differing from number of figures in the target.

Eighty men fire at 40 prone figures for one minute at a range of 700 yards.

In this case it becomes simply a question of determining *in what time* it would take a number of riflemen equal to the number of figures in the target to deliver an amount of fire equal to that actually delivered.

In this case 40 men firing for *2* minutes would give the same amount of fire as 80 men for 1 minute, and therefore should strike 63 per cent or 25 of the figures.

Example 4.—Targets on front other than 1 figure per yard.

Sixty men fire at 60 prone figures on a front of 120 yards for 2 minutes at a range of 600 yards. As the vulnerability of this thin line is only half that of a line of normal density, then the standard is sought in the column indicating half the time actually consumed. In this case the amount sought is at the intersection of the 600-yard line and the 1-minute column and is found to be 48 per cent, or 29 figures, which is the number of figures that should have been struck.

These tables may be used also in determining comparison, factors of time and men, and in formulating problems with ball cartridges as to duration of fire and number of rounds to be issued.

372. Time and men comparison.—(*a*) What time should have been required by the firers to have gotten the result obtained?

(*b*) How many men with proper sight setting, rate, and distribution could have produced the same number of casualties in the actual time consumed by the firers?

Considering the first question (*a*) and referring to the example where 100 men fired for two minutes at a range of 900 yards on 100 kneeling figures on a front of 100 yards with a result of 24 figures, or 24 per cent, struck, visibility perfect:

Follow the range line (900) to the right until encountering an amount approximately equal to the percentage of figures actually struck. The heading of the time column in which this amount is found will be the answer sought. In this example, the percentage 24 is found on the 900-yard line. As this amount, 24, is found in the ½-minute column, the umpire arrives at the conclusion that the firers should have accomplished what they did in one-half minute.

Considering the second question (*b*) and referring to the same example:

This is answered by solving this simple proportion:

The time actually consumed: The time that should have been consumed:: Number of men actually firing: The number of men required.

In this example it would be $2 : \frac{1}{2} :: 100 : x$, or $x = 25$. That is, 25 men should have been able to strike 24 out of 100 targets in two minutes' firing.

Just how many of these bases of comparison are used by the umpire depend upon the nature of the problem and whether, in his judgment, the tactical situation calls for additional emphasis of the need for economy of time or economy of men.

373. Duration of fire and number of rounds.—(*a*) How long to continue the fire at any particular target?

(*b*) How much ammunition to issue for any particular problem?

(*a*) It is obvious that if the fire is continued too long at a target the percentage of figures struck ceases to be an indication of the efficacy of the fire. Thus, for example, no conclusions of value could be drawn from the results of fire continued for more than one minute on kneeling figures at 200 yards, or for more than 3½ minutes at prone figures at 400 yards.

Hence in drawing up the problem the umpire may decide on what percentage of figures he desires to have struck in any target, and then (from the table) he can determine for what period he can allow the fire to continue.

For example: How long shall fire continue in order to strike 30 out of 100 prone figures—normal front—at 800 yards? From

the table, opposite range 800 in the 1-minute column, is found 32, the nearest percentage to 30.

For an equal number of rifles this would be about one minute.

For 200 rifles, half the time.

For 50 rifles, double the time.

For half the density of target (1 figure per 2 yards of front), double the time.

(*b*) To estimate the amount of ammunition to issue for any particular exercise, multiply the duration of fire by the correct rate for that range (see Table I, under "Statistical record") or by the umpire's estimated rate. It is advisable to add 10 per cent to this estimate in order to provide ammunition to men whose rate of fire is greater than that ordered. This to equalize the ammunition unexpended by men who are using a slower rate than ordered, due to either lack of training, ground, or vegetation preventing view of assigned targets, to jams, etc.

Assume an exercise in which four targets of prone figures were to be used and fire to be continued until 30 to 40 per cent of the figures have been struck. The range to target No. 1 is about 800 yards, to No. 2 is 700 yards, to No. 3 is 600 yards, and to No. 4 is 500 yards.

The issue of ammunition would be computed as follows:

Target.	Range.	Time.	Rate.	Rounds.
1	800	1	5.8	5.8
2	700	1	6.6	6.6
3	600	¾	7.5	5.6
4	500(B.S.)	¾	8.3	6.2
				24.2
Add 10 per cent				2.4
				26.6

That is, in this exercise, 30 rounds per man would be issued—30 instead of 27 merely to save time by issuing only full clips.

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